Lectures

ON

Pharmacy

REVISED ACCORDING TO THE
EIGHTH DECENNIAL REVISION
OF THE
PHARMACOPOEIA OF THE U.S.A.

By C. S. N. HALLBERG, Ph. G.,
CHICAGO COLLEGE OF PHARMACY, THE SCHOOL
OF PHARMACY, UNIVERSITY OF ILLINOIS.

CHICAGO:
G. P. ENGELHARD & COMPANY,
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MCMV

INTRODUCTORY.

The design of these Lectures is to present a course of instruction in Pharmacy and its allied branches to those actively engaged in the preparation, compounding and dispensing of Drugs and Medicines.

It is believed that this object may be best accomplished by presenting the instruction in the most simple manner possible.

To make it thorough and comprehensive, it should begin at the foundation, and then, by easy steps, advance to the more difficult problems and branches of the sciences contributing to the practice and the art of Pharmacy.

The Lectures are therefore arranged with the view of being as easily understood as the subjects treated will admit, while at the same time it is sought to make the information sufficiently complete to do the topics justice. The information embraced in the Lectures is therefore given in as condensed a form as practicable, without in the least detracting from perspicuity, or omitting anything a knowledge of which involves important facts or observations.

Reference is sometimes made to such standard text-books as are recommended for the Course whenever it is thought desirable further to elucidate a topic, and when such additional information would prove too voluminous for these pages.

In this connection it will be found important to note that, while there has been no rigid discrimination in the selection of books for reference—those usually found in the average pharmacy having been chosen—yet the use of the old Pharmacopœias and the older editions of Dispensatories based upon these are neither appropriate nor reliable.

In common with all institutions for teaching Pharmacy, and with other agencies operating in harmony with the progress of Pharmacy, the instruction in this course of Lectures is based upon the U. S. Pharmacopœia.

The Lectures have therefore been largely rewritten and revised in accordance with the eighth decennial revision of the U. S. Pharmacopœia, which has superseded the U. S. P. of 1890, having gone into effect or become official September 1, 1905.

THE DEVELOPMENT OF PHARMACY.

The art of Pharmacy is of the greatest antiquity. Its origin is contemporaneous with the earliest periods associated with the study of Nature in the discovery of substances for the relief of suffering and cure of disease. In early times medicines were usually prepared by those who administered them, and there was consequently no great distinction between the physician and the pharmacist.

The use of drugs is mentioned in the Bible, and Egyptian papyrus of 3300 B. C. gives directions for the preparation of medicines. The first medical author was Hippocrates, who is regarded as the Father of Medicine. Others who followed him are Asclepiades and Diascorides. Aesculapius was the God of Medicine represented by a man with a serpent staff, while Hygeia was the Goddess of Health, typified by a woman pressing the poison from a serpent's fangs and collecting it in a cup for use as medicine. The serpent was the symbol of life, and the two figures were designed to represent the physician having conquered the serpent, while his help-mate, the pharmacist, is preparing the medicine.

Galen, who lived in Rome (A. D. 131), collected in seven great books all medical knowledge, and these books were the authority on medicine until superseded by the teachings of Paracelsus in the sixteenth century. The medicines of Galen were almost exclusively organic, i. e., vegetable and animal, and largely represented by extracts, and for this reason extractive preparations are called galenic "galenicals." Up to this time the work of chemists was chiefly concerned in the search of the Elixir for the prolongation of human life, and of the philosopher's stone for the transmutation of the base metals into gold—Alchemy. Paracelsus directed the work in the preparation of medicine, and introduced chemicals in medicine—antimony, mercury, copper, arsenic, iron and their compounds and preparations.

This led to the establishment of pharmacies, which previous to this time had only been shops for the storing of drugs. Pharmacy may therefore be said to have begun with Paracelsus, that is, its practice was introduced along with and became more or less separate and independent from the practice of medicine, which, it may be said, is yet based on the theories of Paracelsus and his school.

Dispensatories.

In the fifteenth century appeared the first medical book called a "Dispensatory" by Basil Valentine, which was followed by similar works by eminent medical authors in Germany and in the

other European countries, the first dispensatory in the English language being that of Edinburgh.

In the United States the first Dispensatory was that of Dr. John Redman Coxe, of Philadelphia, in 1810, and of Dr. James Thacher, of Boston, the same year. Neither of these reappeared. The U. S. Dispensatory was first published in Philadelphia in 1828, by Dr. George B. Wood and Franklin Bache, being now in the eighteenth edition. The American Dispensatory, by Dr. John King, appeared in Cincinnati in 1859, being now in its third edition. The National Dispensatory first appeared in Philadelphia, in 1878, being now in its fourth edition. The Standard Dispensatory by Professor C. Lewis Diehl is announced for early publication.

The Practice of Pharmacy.

The practice of pharmacy consists of: The collection, identification, valuation, preservation, preparation, compounding and dispensing of drugs, chemicals and medicinal substances, including related information concerning sanitary. hygienic and surgical articles and appliances.

The collection now consists simply in purchasing the articles while formerly many substances, especially crude drugs, were gathered by the pharmacist.

Identification is very important, since it is essential to know whether or not the particular article desired is secured. If a drug, to determine if it be true or false requires application of the sciences of pharmacognosy, of botany, microscopy, histology, zoology. If a chemical, its character is determined by various chemical and physical operations. Identification is all-important; its neglect fatal.

Valuation—determination of purity, quality and strength—is not only necessary to insure safety, but is also essential to guard against extortion in price. This involves tests similar to identification as well as chemical assay.

Preservation is often neglected through ignorance or carelessness. The character of substances must be considered in order to prevent deterioration. Quality must be maintained, and loss must be avoided if possible.

Preparation refers to the pharmaceutical operations necessary to present drugs, chemicals and medicinal substances in proper form.

Compounding is the art of mixing or the elaboration of substances for preparations in the many various forms suitable for medicinal administration.

Dispensing is the art of disposing of the medicine in its most attractive form with due precaution against error and reasonable

certainty of fair compensation for material, labor, skill and service.

The distinction between these three last named is frequently overlooked and yet it is very evident such differentiation is of considerable practical value.

The Pharmaceutical Sciences.

Since substances from every source and of all nature are used in the treatment of disease, the practice of pharmacy comprises a knowledge of every natural science.

Botany (botanae—plants), the science of plants.

Pharmacognosy (pharmakon—drug, and cogno—to know), the application of botany for the identification of parts of plants and when applied to the study of their minute structure is called vegetable histology.

Materia Medica (matter medicinal) is a term applied in pharmacy to the description of pharmacognosy, but is often used to indicate the Natural History of Drugs and in Medicine also the medicinal properties and uses of Chemicals.

Pharmaco-dynamics refers to the physiologic action of medicinal substances in the normal condition or healthy body, often improperly called pharmacology.

Therapeutics refers to the action of remedial agents in disease and the form of administration, and comprises not only medicinal substances but also diet, hygiene, sanitation ,and application of physical laws and phenomena, massage, climatology, electricity, magnetism, light, etc.

Toxicology—the science of poisons—refers especially to the action of "poisons," and their detection in the body.

Physics (physis—nature), the laws governing and phenomena relative to the forces of nature; heat and molecular motion and changes in aggregation—states involved in pharmaceutical processes and operations.

Metrology (metron—measure), science of measures and weights.

Mineralogy (minera—earth, logos—science), the science of minerals and Crystallogaphy (cristaneo—crystal, graphos—describe), description of crystal systems.

Chemistry (chymeia—mixture), the science of constitution of matter, its changes and reactions specialized in various applica-

tions—theoretical practical, applied, pharmaceutical, analytical, synthetical, inorganic, organic, electro-chemical.

Pharmacology (pharmacon—logos) is the science of Drugs or Medicines in its broadest sense, comprising all the sciences here enumerated, except those pertaining to the therapeutics of non-medicinal substances.

A course of pharmacy, as in these lectures, includes: Physics, the pharmaceutical classification of drugs, chemical and medicinal substances, their preparation, compounding and dispensing, and incidentally their medicinal, technical and domestic uses and dosage.

Pharmacopoeias.

The Dispensatories performed a valuable service, but being unofficial publications and lacking in uniformity in vital essentials, they soon led to a desire for works which should be issued by joint medical and state authorities.

Such works were called Pharmacopoeias (pharmacon, drug, and poeion, to make).

The first work of this character was compiled by Valerius Cordus in 1546 and was adopted by the city of Nuremburg, Germany. This was followed by Pharmacopœias published in the most important cities in Europe, such as that of Paris in 1548, Lyons (1552), Berlin, and other cities in Germany, and in London, Edinburgh and Dublin. These works were in the last century superseded by works of national authority until today every civilized country has a Pharmacopœia. The following names with the latest edition and abbreviated designation are the most important:

British Pharmacopœia, 4th edition, 1898. B. P. or P. Br.; German Pharmacopœia or Arznei Buch fur das Deutsche Reich, 4th edition, 1900. D. R. or Ph. Ger.; Pharmacopea Austriaca, III, 1889; Helvetica III, 1893; Pharmacopee Francaise Codex Medicamentarius, 1886; Suppl. 1895, Ph. Fr.; Nederlandica III, 1889; Suecica VIII, 1900; Belgica II, 1885; Danica, 1893; Japonica II, 1891; Norwegica III, 1895; Italia, 1892; Hispanica VI, 1884; Russica, 1891.

A Pharmacopoeia may be defined as an authoritative book establishing Standards for the identity, quality, purity and strength, and giving Directions for the preparation, valuation, preservation and compounding of drugs, chemicals and medicinal substances.

The Object of a Pharmacopoeia is to secure uniformity in medicines, its **function** being to afford pharmacists and physicians authoritative standards for medicinal articles. It will be observed

that this comprises practically all the functions of the practice of pharmacy as previously mentioned.

The Identity of Articles is necessarily first dependent on the name, hence the system of naming or Nomenclature (nomen, name —callare, to call) is of primary importance. The Nomenclature of the U. S. Pharmacopoeia is illustrated in, for example:

Hydrargyri Chloridum, Mite; Mild Mercurous Chlorid; Calomel.

The first name is in Latin and on it the alphabetic arrangement is based and it is called the Latin **title.** The second name is the English title, while the third (Calomel) is the English name. This article has nearly half a hundred other names: mercurius dulcis, Hydrargyri submurias, protochlorid of mercury, etc. These are called **synonyms.**

The identity is further confirmed by the chemical formula (Hg_2Cl_2), and by definition, description, tests, reactions, etc., through which also the quality, purity and strength may be determined.

The directions for the preparation, valuation, preservation and compounding are similarly designed to insure medicines of uniform strength and stability.

The first Pharmacopœia for the U. S. was published in 1820, being the work of a Convention composed of delegates from medical societies and colleges which met in Washington. It has been revised every ten years since that time, that of the 1900 convention being the Eighth. The Convention which meets every ten years (decennially) is composed of Delegates from the State and National Medical and Pharmaceutical Associations, incorporated Medical and Pharmaceutical Colleges and from the medical service of the Federal Government, the Army, Navy and Public Health and Marine Hospital Service. The convention elects a Committee of Revision of twenty-five members, composed of therapists, chemists, pharmacognocists and pharmacists; instructs the committee on important changes desired, elects a Board of Trustees of five members who, together with the officers of the Convention and the chairman of the Committee of Revision, arrange for the publication of the book.

Owing to the interim of several years from the year of the convention to the appearance of the book the period covered will hereafter be designated by the numbered revision; instead of by the year of the convention, i. e., U. S. P. viii, instead of 1900 or 1905.

On the publication of the U. S. Pharmacopœia a certain time is specified when it is to go into effect, that is, become legal and supersede the former edition. The time set for the present 8th edition was September 1, 1905, when the U. S. P., VIII., becomes **official**; a term used to designate its authoritative character, and will so remain until supplanted or superseded by a later work.

A few years after the Revolutionary war a Pharmacopœia was published by Dr. Wm. Brown in Lititz, Pa., and the Massachusetts Medical Society also published a Pharmacopœia about 1810. But these works were used only locally and can not be regarded as pharmacopœias having national authority.

METROLOGY.

Metrology, from **Metron**—measure, **logos**—science, is the science of weights and measures.

All matter has three dimensions, viz.: Length, breadth and thickness, which are determined by measure.

Measuring is comparing the dimensions of a substance with some Standard for comparison, such as the

Length, extension or linear, with the Yard, inch, Meter; the **breadth,** surface, or square, with the Acre, Hectare; the **thickness,** bulk, volume or cube, with the Bushel, Gallon, Liter.

The Standards for the square and cube are derived from the linear or measure of length.

Matter also has weight, that is, all matter is attracted toward the Earth and the weight of a substance is the downward pressure which the Earth's attraction causes it to exert. The measure of this attraction is determined by **weighing**: that is, comparing with a certain fixed quantity of matter and expressing the result in so many units of the quantity, such as Pound or Gram.

The relation of the weight of any kind of matter to its volume is called Specific Gravity; and that of volume to weight, Specific Volume.

The subject of metrology comprises therefore:

1. Measures of lengths, area and volume.
2. Weight, the measure of gravitating force.
3. The relations of weight and volume.

Measures of Length and Area.

The measures of length and area are of but little importance in pharmacy and yet it is essential to remember that upon the **linear** or length measures all standards for comparing volume and weights are based. **The standard unit** of the measure of length in common use is the English Yard, which is divided into 36 inches; 12 inches being one foot. That from which the respective divisions and multiples are derived is called the standard, primary or fundamental unit.

Measures of Volume.

The volume or bulk is divided into "liquid" and "dry" measures.

Liquid measures have as the standard unit the gallon (Symbol C, from Congius) which by act of congress contains 231 cubic inches.

Following is the table of **Apothecaries** or **Wine** measure:

60 minims (Min. or M.)..................	=1 fluidram.
8 fluidrams (fl. dr.).....................	=1 fluidounce.
16 fluidounces (Latin uncia, fl. oz.).......	=1 pint.
8 pints (Oct. or O. from Octarius—⅛)..	=1 gallon.

Besides these Apothecaries' Measures, there is the barrel (bbl.) equal to 31½ gallons.

The drop, while supposed to be equal to a minim, varies considerably with different liquids, also with the shape of the lip and the size of the container from which it is dropped, the quantity of the liquid and the rapidity with which it is allowed to drop.

While water dropped from a small flask with a very thin lip runs nearly 60 drops to one fluid dram, under other conditions it may require only 35 drops. With other liquids the variation is still greater, ranging from 40 in fixed oils and glycerin to 120 in alcohol, 150 in ether to 200 in chloroform.

Domestic measures comprise: Teaspoonful equal to 1 fl. dr.; dessertspoonful, 2 fl. dr.; tablespoonful, ½ fl. oz.; wineglassful, 2 fl. oz.; teacupful, 4 fl. oz.; tumblerful, 8 fl. oz.

The drop is too indefinite a quantity by which to measure or administer medicines. Solutions ordered given by drops should always be dispensed accompanied by a minim pipette—a short glass tube drawn out to a fine point and fitted on the larger end with a small rubber bulb; compressed with the fingers the air is expelled and, on being immersed in the liquid, the tube is quickly filled, yielding drops upon slight pressure. A pipette, having an external diameter of ⅛ inch, will yield about 20 drops to 16 minims.

The measurement by spoonfuls is quite as inaccurate as by drops. Some teaspoons hold twice as much as others and it is difficult to fill them uniformly. Graduated medicine glasses should always be furnished with liquid medicines ordered given by the spoonful.

Measures used in pharmacy are usually made of glass, graduated according to the Apothecaries' Measure or the Metric System. They are either conical, with straight sides tapering, bell-shaped or cylindrical. For accurate measuring the tall cylindrical measures are the best since the **meniscus**—the level surface of the liquid—can be most readily compared with the graduated marks or rings. For analytical work bulb pipettes. also Burettes—narrow glass cylinders or tubes drawn out to a point and graduated to 1-10 Cc or less—are used. Porcelain measures, graduated on the inside, are also used as well as metal-tinned iron, copper or enameled ware, from one quart to several gallons' capacity.

Measures of Weight.

Since weight is due to gravity, and gravity is in proportion to the quantity of matter contained in the attracting bodies, weight, other things being equal, will vary as the quantity of matter varies, and a body with twice the quantity of matter or twice the mass of another body, will weigh twice as much. We may therefore estimate the quantity of matter a body contains by weighing it.

The weight of a substance at the sea-level is not quite identical with that of the same substance at a mountain-top, for the reason that in the latter instance, being farther from the Earth's center, the attraction is less; and for the same reason it is not so great at the equator as at the poles. It must also be borne in mind that in weighing a body in the air, the air has a buoyant effect and diminishes the weight of the body in the ratio of the weight of the air which it displaces. Of two bodies, therefore, containing precisely the same quantity of matter, but the one a large body, say like a piece of cork, and the other a small one, as a piece of lead, the lead will weigh the more in the air, although a mere trifle.

In ordinary weighing, where extreme accuracy is not required, no corrections need be made for latitude or distance from the Earth's surface, but in chemical research and in weighing very light bodies, these and the buoyant effect of the atmosphere must be taken into account.

For this reason the "Barometric pressure" is often referred to in connection with the weight of substances, and the standard unit weighed in the absence of air pressure, namely, in vacuum.

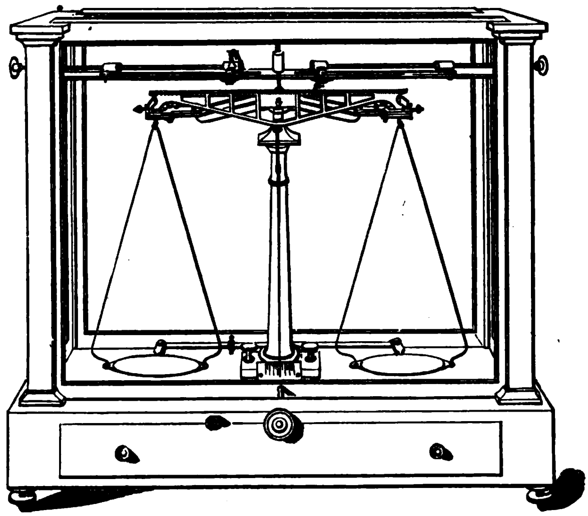
Since, also, bodies expand by heat and contract by cold, the temperature must frequently be taken into account in weighing a body.

The temperatures most commonly employed are 15°C or 25°C, equivalent to 59° or 77° Fahrenheit. For scientific work the temperature is referred to 4°C, the maximum density point of water.

The Balance.—The **principle** upon which the scale or balance is constructed is so simple and well known as to need scarcely any description. With the use of fine instruments, however, such as the prescription-balance, it is well to bear in mind that they should be treated with care. The more sensitive a balance, the more delicate is the construction, especially of the knife-edges upon which the beam rests, and that of the knife-edges of the extremity of the beam from which are suspended, by means of wire, the pans.

The simplest form of Balance is the single-beam balance. To insure accuracy, the point upon which the beam rests must be

just above the center of gravity of the balance; the point of suspension of the pans must be in a line absolutely with the ful-



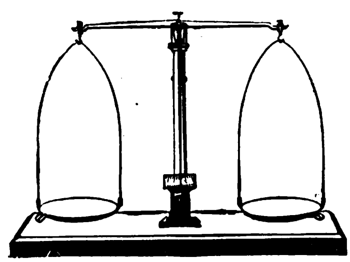
SINGLE BEAM BALANCE.

crum; the beam must be of sufficient strength to support the weight without bending, and the arms of the beam must be of equal length.

A fine balance should always be inclosed in a glass case to keep it free from dust, and more especially to protect it from the corrosive effect of acid fumes, etc., which attack the steel-knife edges, and thus impair their sensitiveness.

The box-dispensing scale is constructed upon the compound-

PRESCRIPTION BOX SCALE.



PRESCRIPTION BEAM SCALE.

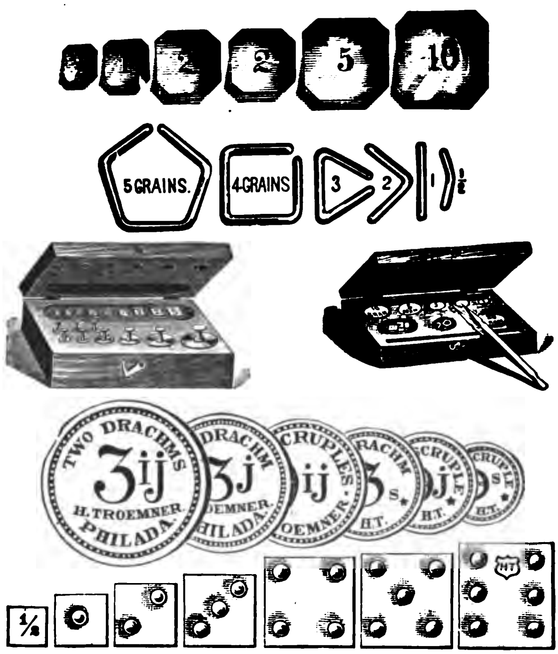
lever principle, and is more convenient to use, easier to keep clean, but more liable to get out of order. It answers admirably for dispensing and prescription work, but is not sufficiently delicate for analytic purposes.

The Single-lever balance is represented by the scoop or platform scales and the sliding weight balance of Troemner. The

TROEMNER PARTS BY WEIGHT BALANCE.

Torsion balance is a compound-lever balance on gold-wire bearings.

The pans of a balance should always be allowed to rest, to prevent oscillating when not in use, which may be best accomplished, in the absence of a permanent fixture accompanying the balance for that purpose, by placing one pan on top of the other until wanted. Care should also be taken that corrosive articles, such as iodin, mercuric chlorid (corr. sublimate), and potassium and sodium bromides and iodides, etc., when dis-



PRESCRIPTION WEIGHTS.

pensed, should be weighed in glass pans, which usually accompany the balance, or in watch glasses of equal weight.

In weighing adhesive substances, such as extracts, etc. small pieces of

white cardboard of equal weight should be used. The extract required is, by means of a spatula, placed upon one piece, while the other serves as a counterpoise or tare upon the opposite pan. A fine balance will remain in good condition much longer when it is reserved for weighing smaller quantities only, say below one dram. It will be found very convenient to have a coarser scale on the dispensing counter for weighing quantities above one dram and for ointments, etc. A small box or vial of shot, or some similar substance, should always be near at hand, to be used in taking the tare of bottles or containers, when it is necessary to weigh fluids, or whenever a receptacle is used in weighing.

The weights used in weighing are of **metal,** usually iron or brass, whose downward pressure is compared and marked according to some fixed standard.

Weights for prescription scales are made of aluminum and of German silver and platinum for analytical balances. These weights should be preserved in a small box or drawer, protected from dust and from the corrosive action of chemicals which would impair their accuracy. They must be kept bright and clean to be reliable, and for this reason should be handled with a pair of light forceps instead of with the fingers. Weights should be secured from reliable sources, or tested as to their accuracy.

Liquids, as a rule, are measured while solids are weighed; nevertheless, it is frequently required that a certain liquid be weighed. While the difference between weighing and measuring some liquids is not very great, yet with many it is considerable and requires that the specific gravity be considered.

SYSTEMS OF WEIGHTS.

The weights in use in the United States are: Avoirdupois (for commercial transactions), Troy, Apothecaries' (used in medicine), and the Metric System (or International, or Universal).

Apothecaries' weight, together with the U. S. Liquid Measures, were employed in the U. S. Pharmacopœia until 1880, when they were superseded by decimal parts by weight, and in 1890 by the Metric system.

While not used to designate quantities officially, the U. S. Pharmacopœia refers to "Customary" weights and measures, and gives their metric equivalents. Since formulas and prescriptions are largely written in and compounded after Apothecaries' weight, and drugs and chemicals are bought and usually dispensed by Avoirdupois, this causes considerable confusion, and unless taken into account, may result in error and loss. For example, in calculating the cost per grain of expensive alkaloids, it should be remembered that those being sold by Avoirdupois

contain in an one-eighth ounce package 54 grains instead of the 60 grains contained in one-eighth ounce Apothecaries' ounce, or one dram.

The principal reason for continuing the use of Apothecaries' weight in formulas and prescription-writing is that the dram is nearly equal to a fluidram, which is approximately equal to the most common liquid measure—the teaspoonful. Another reason is the seeming convenience of the binary division of both the weight and the liquid measures, that is, their quantities may be readily multiplied or divided by 2 and its multiples, without entailing any unwieldy fractions, as is usually the case with decimal numbers.

Thus, in prescribing a dose of some powerful substance in solution, for example morphine sulphate, one-eighth grain in a teaspoonful dose, the calculation is easily and quickly made, say, for one fluid ounce, viz., one grain in 8 fluidrams, or one fluid ounce. While this seems to be more convenient than decimal calculations according to the metric system for similar quantities, the advantages are more apparent than real, and disappear with sufficient familiarity and experience with the latter. Besides the metric quantities—liquid and weight—bear a uniform relation to each other, which the customary weights and liquid measures do not, and therefore insure greater accuracy.

Avoirdupois Weights:

16 ounces=1 pound=7,000 grains; or 1 oz.=437.50 grains.

Apothecaries' Weights:

20 grains (granum, gr.)		=1 scruple.
3 scruples (scrupulum, ℈)	=60 gr.	=1 dram.
8 drams (drachma, ʒ)	=480 gr.	=1 ounce.
12 ounces (uncia, ℥)	=5760 gr.	=1 pound.

Troy Weights:

24 grains		=1 pennyweight.
20 pennyweights	=480 grains	=1 ounce.
12 ounces	=5760 grains	=1 pound.

The symbol for pound (lb.) is derived from the Latin word libra.

From this comparison it will be seen that the Apothecaries' and the Troy are the same in the weights they have in common, viz., pounds, ounces and grain, but that they have nothing in common with the Avoirdupois except the grain. The grain is the only weight alike in all three systems.

Symbols are used to designate the weights in the Apothecaries', as shown above, but abbreviations only in the other systems (except lb.). The quantities of the Apothecaries' weights are des-

ignated by Roman numerals placed directly after the symbols, thus ℥i (1 ounce); ʒviii (8 drams); ℈xxiv (24 scruples); gr. ccccIxxx (480 grains).

Contrast of Weights and Measures.

Unit	Grains	Fl. Dram	Dram	Oz. Av	F'. Oz.	Oz Apoth	Lb. Apoth.	Lb. Av	Pint	Gallon
Minim ..	0.95	60		...	4·0	....	..		1,680	61,440
Grain....	1	57	60	437½	456	480	5,760	7,000	7,30[illegible]	58,418
Fl Dram	57	1	....	.....	8	...	.. ..	. ..	128	1,024
Dram ..	60	......	1	. ..	.....	8	96	.....	......	......
Oz. Av.	437½	......	.....	1	.. ..	.....	.....	16	....	.....
Fl. Oz..	456	8	....	....	1	......	.....	......	16	128
Oz. Apoth	480	....	8	....	....	1	12	......	......	......
Lb. "	5,760	.....	96	..	......	12	1	.....	......	......
Pd Av..	7,000	......	.....	16	......	......	......	1	......	......
Pint.....	7,302	128	.....	......	16	......	.....	.....	1	8
Gallon...	58,418	1,024	....	......	128	.....	....	.....	8	1

By reading down the column the various denominations of each unit of weight and measure are clearly shown.

It will be observed that the principal units of the two systems of Weight and the Liquid measures are not equal (or commensurate). Neither the pounds nor ounces are equal, nor is the fluid ounce equal to the other ounces, for "a pint is not a pound the world 'round."

As already shown, weights and measures are derived from each other, and to compare their quantities they are converted into each other. If a Pint were a Pound (Avoirdupois) their Ounces being a sixteenth part of each would be equal. If a pint weighed 7,000 grains, then one fluid Ounce would weigh 437½ grs and a fluidram 54 11-16 grs, etc. But a Pint weighs considerably more than a Pound, viz., 7,302 grs, because this is one-eighth of the weight of one U. S. Gallon of water, which weighs 58,418 grs at its maximum density 4°C in vacuo. One-sixteenth of this is 456 grs, or one fluid ounce; one-eighth, or one fluidram, is 57 grs, and one-sixteenth equals 0.95 grain, or one minim. At higher temperatures water weighs less; for example at 15°C one gallon weighs 57,796 grains and one pint, therefore 7,292 grs, a difference of 10 grains, and for great accuracy, therefore, corrections for temperature must be made (see U. S. Ph.).

1 cubic inch=252.892 grains.
1 gallon=231 cubic inches=58,418 grains.
1 pint=58,418÷8=7,302 grains.
1 fluidounce=7,302÷16=452.2 grains.
1 minim=456.2÷480=0.95 grains.

THE METRIC SYSTEM.

The Metric System of weights and measures was originally introduced in France at the close of the eighteenth century; hence it is frequently termed the French system. Owing to its decimal parts it is also called the **decimal** system. This system has gradually displaced all other systems of weights and measures throughout the continent of Europe, and being the only legally recognized system in all countries, except the United Kingdom and its colonies, and the United States of America it has become known as the International or "Universal" system.

Because of its simplicity in construction, regularity and convenience in exact calculations, it has become the only system for scientific work, and is no doubt destined soon to displace the older systems in art and commerce throughout the civilized world. Through our system of decimal numbering—ones, tens, hundreds, thousands, etc.—the **monetary** systems of all civilized nations except Great Britain have also become decimal.

The functions of money and weights and measures are so closely related and interdependent that a **decimal** system of one practically demands a **decimal** system of the other. The decimal system of money was one of the privileges accorded the people of the United States by early adoption, but, while adopting this great improvement over the old English pound, shilling, and pence, the old English weights and measures, based on the penny-system, were unfortunately retained.

The U. S. Government in 1867 made the Metric system obligatory in the three branches of its medical service—the Army, Navy, and Marine Hospital—and also legally permissible throughout the Union, and measures to make its use obligatory throughout the country have been pending for years in the Congress.

There is some excuse for retaining the old systems in the United Kingdom but none whatever in the United States with its decimal proportions of the **dollar,** the **dime,** the **cent** and the **mill,** based upon the same principle as that of the Metric system.

Although employed in medicine to some extent since 1867, the first important attempt to introduce the Metric system was when the National Pharmacopœial Convention of 1880 instructed the committee to revise the U. S. Pharmacopœia in accordance with the Metric system. The committee, however, compromised by employing the system of decimal **parts** or **proportions by weight,** instead, and not until 1890 was the system adopted for the U. S. Pharmacopœia in the seventh decennial revision.

The objections to the adoption of the Metric system are: first, that being decimal it cannot be as easily divided on the binominal plan (halves, quarters, eighths, etc.,) as the older systems based on this principle of bisection. This weakness adheres also to the Dollar, which cannot be bisected further than the quarter, but it is an inconvenience more apparent than real and easily overcome.

The second objection made to it is, that the Orthography, the designation of the respective quantities, is not distinct, and is liable to create confusion and cause error. In this respect it shares the objection to all systems. There is no more liability to inaccuracy in this respect than in designating money amounts by the Dollar unit and its divisions on the decimal plan. Carelessness in designating quantities, or ignorance in their interpretation, is common in the older systems. Thorough familiarity with the principle, and accurate knowledge and care in its use, will demonstrate the **Metric system** to be as free from error as any of the older systems.

The Metric System is based upon the meter.

The Meter is the **unit** of linear measurement being the ten-millionth part of one-fourth of the circumference of the Earth (the quadrant). It is, therefore, the one forty-millionth part of the entire circumference of the Earth taken around the Poles (measured by the **meridian** and not by the **equator**).

One meter is equal to 39.37 + inches.

The Liter is the unit of liquid measure and is the cube of one-tenth of the Meter, which is equivalent to one thousand cubic centimeters. Quantities of one liter or less are usually expressed in cubic centimeters (abbreviated c.c.). The liter is equal to a fraction over 2 pints.

The Gram is the unit of weight and is the weight of one cubic centimeter of pure water in vacuo at its maximum density (4°C.), equivalent to 15.432 grains.

These units (Gram, Liter, Meter) are divided or multiplied to express smaller or larger denominational quantities by simply moving the decimal point to the left or right. To designate these quantities, Latin prefixes (deci, centi, milli) are used to describe denominations less than the unit and Greek prefixes (Deka, Hecto, Kilo) those more than the unit, the latter also being written with a capital letter as will appear from the following:

Metric Measures And Weights.

Linear.	Meters
1 Kilometer	=1,000.
1 Hectometer	= 100.
1 Dekameter	= 10.
1 Meter	= 1.
1 decimeter	= 0.1
1 centimeter	= 0.01
1 millimeter	= 0.001

Liquid.	Liters	
1 Hectoliter	=100.	
1 Dekaliter	= 10.	
1 Liter (L)	= 1.	=1,000cc.
1 deciliter (dcl)	= 0.1	= 100cc.
1 centiliter (cl)	= 0.01	= 10cc.
1 milliliter (ml)	= 0.001	= 1cc.

Weights.	Grams.
1 Myriagram	=10,000.
1 Kilogram	= 1,000.
1 Hectogram	= 100.
1 Dekagram	= 10.
1 Gram (Gm)	= 1.
1 decigram (dcg)	= 0.1
1 centigram (cg)	= 0.01
1 milligram (mg)	= 0.001

Equivalents In Customary Measures And Weights.

1 Meter=39.37 inches; Liter=33.81 fl. oz.; Gram=15.432 grains.

By simply moving the decimal point in the above to the right or to the left, we may multiply or divide to secure the equivalent of any one of the metric quantities in the table, as follows:

		Grains.	Oz. Apoth.	Oz. Av.		
1 Kilo......	=1,000 Gm.	=15,432.356	=32	=35	= 2 lbs. av. 3 oz.	120 grains.
1 Hecto....	= 100 Gm.	= 1,543.235	=3.2	=3.5	= 25 drams.....	43 grains
1 Deka.....	= 10 Gm.	= 154.323	=		2 drams.....	34 grains.
1 Gram....	= 1 Gm.	= 15,432	= (approximately)			15.5 grains.
0.1 gm.....	= 1 dcg.	= 1.543	= (approximately)			1.5 grain.
0.01 gm....	= 1 cg.	= 0.154	= (approximately)			1-6 grain.
0.001 gm...	= 1 mg.	= 0.015	(approximately)			1-64 grain.

	Cc.	Fl.Oz.	Fl.Dr.	Minims.
1 Liter	=1,000	=33.81 (34)	=270	=16,200
1 dcl.	= 100	= 3.38 (3.4)	= 27	= 1,620
1 cl.	= 10	= 0.34	= 2.7	= 162
1 ml.	= 1	=	= 0.27	= 16

Ready Equivalents.

Various methods have been proposed for adapting the metric weights and measures to our apothecaries' weights and measures used in prescription writing without entailing calculations in fractions. The method of taking 32 Grams as equivalent to 1 apoth. ounce, and 30 cc. as equal to one fluid ounce seems to be the least objectionable. These equivalents are shown in the following:

32 Gm.=1 oz.; 32÷8=4Gm.=1 dram.

30 Cc.=1 fl. oz.; 30÷8=3.75 Cc.=1 fl. dram.

The following are Gram equivalents:

1 grain.	1 dram.	1 ounce av.	1 ounce apoth.	1 lb. troy.	1 lb. av.
0.0648	3.888	28.349	31.103	373.250	453.592

To convert avoirdupois or apothecaries' into metric weights, the equivalent of the Gram in grains—15.432—should be remembered, as from this the equivalent of all the other denominations are readily obtained. It will aid the memory to note that this number is composed of the first five numerals in reversed order, except the figure 1. In round numbers the Gram is said to equal 15 grains, or, in 4 Grams, 60 grains, which equals 1 dram; thus 4 Grams being multiplied by 8—the number of drams in one ounce—give 32 Grams, equal to one **apoth. ounce.**

To convert metric weights into avoirdupois or apothecaries', the easiest plan is to multiply the quantity in Grams by 15, securing the weight in grains. This is then readily brought back to the larger denominations by dividing it by the number of grains to the dram, ounce or pound. For example, to find the metric equivalent of 1452.5 Grams:

$1452.5 \times 15 = 21{,}787.5$ grains.

$21{,}787.5 \div 7{,}000$ (number of grains in av. pound) $= 3$ lbs. av., 1 oz. av., 350 grains.

With a small number, as, for example, 24 Grams, this calculation may readily be made mentally by adding one-half of the number to the original and multiplying by ten thus; 24 Grams:

$24+12=36$; $36 \times 10 = 360$ grains.

The **Liter** is equivalent to 34 fl. ounces, half a Liter approximating one Pint, sometimes called a **metric pint** (17 fl. ozs.). The division or multiples of the Liter are not used, all fractions of the Liter being expressed in **Cubic Centimeters** (cc.).

The equivalent of the **Meter** is nearly 40 inches, from which the divisions may easily be rendered as follows:

1 decimeter, 4 in.; 1 centimeter, cm., 0.4 in.; 1 millimeter, mm., 0.04. (1-25) inch.

For further comparison of the different systems of weights, refer to "Preliminary Notes," pp. liii. and liv., and also Table of Equivalents in the U. S. Ph.

The advantages of the Metric system consist in:

1. Simplicity of construction, abolishing complex tables.
2. Uniformity, through its adoption in all scientific work.
3. Permanence and Stability of its standard unit derived from the Earth itself.
4. Facility of its multiplication and division by decimal points.
5. Commensurability of all its units and denominations in **weight, volume, linear** measures and our system of **money.**

SPECIFIC GRAVITY.

It is well known that some liquids are lighter than water, **i. e.,** ether, alcohol, etc.; others again are heavier, **i. e.,** glycerin, sulphuric acid, etc. The weight of a certain measure of any of these liquids divided by the weight of the same measure of distilled water is termed the **specific gravity** of that liquid.

Thus, if a bottle hold exactly 1,000 grains of water but of alcohol only 820 grains, the weight of the latter is as 820 is to 1,000.

Water being the standard for comparison, it is stated to be 1., and if the weight of the liquid is lighter than water, as in the above instance, it becomes a decimal of 1., or, in this example, 0.820.

If the bottle is filled with a liquid heavier than water, as, for example, glycerin, of which it would hold 1,250 grains, the weight is compared similarly, viz., 1,000 is to 1,250 as 1. is to 1.25, the specific gravity of glycerin.

The specific gravity (or specific weight) therefore of a substance is its **weight** in comparison with the **weight** of a similar **bulk** or volume of some other substance, or it may be defined as the relative weights of **equal** bulks of **different** bodies, compared with some definite standard at the same temperature.

The standard for comparing the specific gravity of liquids and solids is distilled water at a certain temperature, viz., 25° C. (77° F.).

For gases the standard is Hydrogen at 1.

Importance of Temperature.

Since all bodies expand or contract with changes of temperature, it is essential in comparing this difference in weight that the temperature of the substance be the same as that of the standard for comparison, water, viz., 25° C. (77° F.), except in the case of Alcohol, Wine, and alcoholic liquids generally, which the U. S. Customs and Internal Revenue regulations require shall be taken at 60° F. (15.667° C.).

The Value of Specific Gravity.

The importance of Specific Gravity lies in the fact that through it the **identity,** and often the strength and purity of liquids, may be determined. Thus the percentage of **absolute** acid in official Acids, the percentages of **salts** in the official Solu-

tions, and the amount of **water** present in Alcohol or Glycerin may be calculated from the respective specific gravities. For this reason the sp. gr. is always given in defining the character of chemical liquids in the descriptive text of the U. S. Ph., and in connection with the boiling or congealing points and other physical attributes, determines their identity, purity and strength.

The determination of the specific gravity of liquids, although an operation frequently required in the practice of pharmacy, is rarely understood thoroughly, owing to the fact that no practical demonstration is made at the time the subject is studied.

There exists in the mind of the beginner an exaggerated idea as to the implements or apparatus required for its performance, and as these usually are not at hand, he is disposed to content himself with learning the rules from the books, and, in consequence, soon forgets the principles involved.

This is entirely wrong. Practical demonstration at the time is the only means by which the principle can be thoroughly understood. While it is true that for great accuracy delicately constructed instruments are required, sufficiently accurate results for all practical purposes may be obtained from the use of the ordinary apparatus in every pharmacy.

The Specific Gravity Apparatus.

The apparatus required for taking the specific gravity of liquids is primarily a good balance, sensitive to at least 1 grain, and accurate weights; also a specific gravity bottle of known capacity by weight of water, the most convenient quantity being 50 or 100 Grams or 1,000 grains. Such bottles, termed **pycnometers** are in the market, provided with a glass stopper, and accurately adjusted to hold, when completely filled, the exact weight indicated on them of distilled water at the standard temperature. An opening barely sufficient to admit a small needle (capillary) permits the escape of air, which may have entered the bottle while being filled, as well as any superfluous liquid.

In the absence of a counterpoise, which usually accompanies the bottle, one is easily made from a piece of lead or other metal; or the tare of the bottle may be taken with ordinary weights. When first procured the bottle should be invariably tested as to its accuracy, by filling it with distilled water of the proper temperature, then wiping it dry, and weighing.

Glass-stoppered one-ounce iodine vials may sometimes be found which hold a convenient volume of water, and by making the incision lengthwise upon the stopper with a three-cornered file, an opening is produced which answers the same purpose as the orifice in the more expensive vials above described.

Bottles may also be selected from the ordinary prescription vials; for example a 100 or 120 cubic centimeter vial may be filled with distilled water at 25° C., and marked, with a file on the neck at such point as may indicate a convenient even number of Grams of water. Such vial is not as accurate, however, as the glass-stoppered bottles, nor as convenient, since it involves more calculation.

With these, the veriest beginner in pharmacy may take the specific gravity of any liquid, the simplest knowledge of arithmetic being all that is required. It should be remembered that the thing sought is the **weight** of a quantity equal in **bulk** to a certain volume of water of known weight, or, as above expressed, the **relative** weights of **equal** volumes, or bulks of **different** liquids at the same temperature. A certain volume being decided upon as a standard for comparison, we express that by weight of water, and the weight of an equal bulk of any liquid is divided by its weight. When this standard for comparison can easily be converted into a multiple of ten the division is effected by simply moving the decimal point to the left or right.

The Specific Gravity of Liquids.

To ascertain the specific gravity of a liquid, the bottle should first be rinsed with a little alcohol which volatilizes more quickly than water and leaves the bottle perfectly dry. After having ascertained the temperature of the liquid, which should be that of the ordinary room-temperature, viz., 25° C. (77° F.), the bottle is filled nearly to the top of the neck, the stopper is inserted and the superfluous liquid displaced by it completely removed from the bottle, which is then wiped perfectly clean and dry. The filled bottle is then weighed, after being balanced with the counterpoise. If the weight of the liquid is 1,250 grains the specific weight is 1.25 (1,250÷1,000). The weight of the water, whatever the quantity, is always taken at 1, and the weight of the liquid, whose sp. gr. is sought, is always in proportion to this unit.

The Specific Gravity of Solids.

The subject of Specific Gravity is still better illustrated by the great difference in what is commonly called the "density" of Solid substances. These present much greater variations than do liquids, ranging from such light material as cork or feathers, which float easily on water, to the heavy metals, Gold, for example, which is twenty times as heavy as Water.

This property was first studied by Archimedes, who formulated the principle into a law, viz.:

"Bodies immersed in a Liquid are buoyed up with a force **equal** to the Weight of the Liquid displaced."

This law is applied to determine the specific gravity of Solids by comparing the **weight** of the Solid by the **weight of an equal bulk of Water,** which, as in the case of Liquids is used as the standard at 1.

This is effected by weighing the Solid under water, when, according to the law, it must weigh as much less as the amount of water weighs which is equal to the bulk the solid displaces. This weight of the water displaced is shown by the **loss** in weight of the Solid, when weighed under water, from its original weight **in air.** Then by dividing the original weight of the Solid (in air) by its **loss** in weight under water, the comparison sought is obtained, the quotient representing the **relative** weight of the Solid to an **equal** bulk or weight of Water, or the **specific gravity,** or "density" of the Solid.

Owing to the great variation in density, and to the fact that some solids are **soluble** in and therefore forbid the use of water, and to other causes different methods for taking the specific gravity of solids must be employed.

1. Solids heavier than water:

(a) Solids **insoluble** in Water: This is the most simple of the operations involved. The solid is first weighed in air, or a 10 Gm. brass-weight may be used. It is then weighed under water and found to weigh, say 9 Gm. The loss (1 Gm.) represents the weight of a bulk of Water equal to the bulk of the 10 Gm. brass. By dividing the original weight 10, by the loss 1, the quotient 10 is the specific gravity of the Brass.

The weighing may be effected by placing a Bridge, made from a card-box cover, over one of the pans of the balance so as not to interfere with its movement; a double-beam prescription scale being used. Upon this Bridge is placed a small Beaker nearly filled with water. A silk thread, platinum-wire, or horse hair is attached to the hanger upon the end of the beam, by means of which the brass-weight is suspended so that it is completely submerged in the water contained in the beaker. The equilibrium of the balance is now restored by the required weights on the opposite pans, in this case, 9 Gm., then the weight in air $10 \div$ the loss $1 = 10$, the specific gravity of the brass-weight.

By **displacement** in a Graduated Cylinder the correctness of this process may be proved. Into a 25 cc. cylindrical measure, pour exactly 10 cc. Water, drop into it the 10 Gm. Brass-weight and note the increase in volume of the Water to 11 cc. This proves that the 10 Gm. Weight occupies a volume of 1 cc., or that it is ten times as heavy as the water.

This method is not as accurate as that by the balance. owing to the variation in graduation and the difficulty in accurately determining the **meniscus**—the mean level of the liquid.

(b) Solids soluble in Water.

The operation is the same except that some liquid in which the solid is **insoluble** must be used, for example Alcohol, Oil Turpentine, etc. Instead of dividing the weight in air, however, by the **loss** of weight in the liquid, the difference in the sp. gr. of the liquids must be taken into consideration for as the sp. gr. of the liquid is to the sp. gr. of Water, so is the loss in weight of the solid in that liquid to the loss in weight in water.

A Solid weighs in air 40 Gm.; in Alcohol (s. g. 0.820) it weighs 20 Gm.; loss 20 Gm.; then $40 \div 20 = 2$; $2 \times 0.82 = 1.64$ s. g.

The volume that the Solid occupied was equal to 2 Gm. of Alcohol, but since Water is the standard of comparison, the Alcohol must be reduced to its equivalent weight in Water.

2. Solids lighter than Water.

Use a Sinker. Proceed as in 1 (a), but first attach a small piece of Lead as weight to the wire which is to carry the substance, whose sp. gr. is sought, and after it is immersed in the water in the beaker, restore the equilibrium of the balance by placing the necessary weights on the pan. The substance (a piece of Wood, say 1 Gm.) is now attached to the Lead-Sinker, which when suspended in the beaker, will rise in the water. Sufficient weights are then removed to restore the equilibrium of the balance to that it occupied with the Lead alone, before the Wood was attached. The weight, say 2 Gm., represents the weight of a bulk of water equal to that displaced by the wood. The weight of the Wood in air was 1 Gm.; then $1 \div 2 = 0.5$, the specific gravity of the wood.

By **floating** the Solid in a Liquid in which it is insoluble, and taking the sp. gr. of the Liquid.

A piece of Wax is placed in a glass Cylinder which is half filled with Alcohol, when it sinks. By gradual addition of Water, carefully mixing the liquid by inverting the cylinder, the sp. gr. of the Alcohol is raised so that the Wax, if allowed to move freely, is kept in suspension, because it has the same sp. gr. as the Alcohol. By determining the sp. gr. of the Alcohol (0.90), the sp. gr. of the Wax is also obtained, viz., 0.90.

3. The Specific Gravity of Powders.

By **displacement** in a Liquid in which the Powder is insoluble. 5 Gm. Calomel is placed in a sp. gr. vial—a pycnometer—of say 25 Gm. capacity, which is then filled with Water and weighed. The weight of the contents is 29 Gm., from which the weight of the Calomel is deducted, leaving 24 Gm., showing a loss of 1 Gm., then; the weight of the Calomel, 5÷1 the loss =5. which is the specific gravity of the Calomel.

Hydrometers.

Since a solid body, when weighed in a liquid, varies in weight according to the character of the liquid, its weight being greater in a light liquid—Alcohol for example—than in a liquid of higher specific gravity, such as Water, the specific gravities of liquids may also be determined by weighing weights in Liquids and comparing the loss in weight with the original weight in air. Various Balances are devised on this principle, i. e., Mohr's and Westphal's, in which a glass-weight-thermometer is weighed in the liquid and the equilibrium restored by means of movable weights on the graduated beam.

On the same principle the Hydrometers are constructed. This instrument consists of a glass tube, terminating in a bulb filled with some heavy material such as mercury or shot of such weight as to cause the tube to sink when placed in a liquid and maintain it in an upright position. The weight is adjusted so that the tube may sink to a certain point indicated on the stem by a graduated scale when placed in a certain liquid.

With some of these instruments the liquid for comparison may be a salt solution and the scale composed of arbitrary figures, such as the Baumé Hydrometer, but most of those employed in pharmacy are based upon Water as the unit for comparison, and are provided with specific gravity scales.

These latter, constructed with reference to their adaptation to various liquids, have especially selected scales and are named accordingly: Alcoholometers, Saccharometers, Lactometers, Urinometers, etc.

Baume's hydrometer is of two kinds: (1) for liquids **heavier** than water; and (2) for liquids **lighter** than water.

As these standards are still in use in the arts, the following rules for converting them into sp. gravity are convenient:

For liquids **heavier** than water: subtract the degree of Baume from 145, and divide 145 by the remainder thus obtained; the quotient is the spe-

cific gravity. To convert 30° Baume into sp. gr.: 145—30=115; then 145÷115=1.26 sp. gr.

For converting the specific gravity into Baume, divide 145 by the sp. gr. and subtract the quotient from 145; ans. the °B.: 145÷1.25 sp. gr.=116; 145—116=29°B.

For liquids lighter than water: add the number of degrees to 130, and divide 140 by the sum thus obtained; the quotient is the specific gravity. To convert say 20°B. into sp. gr.: 20+130=150; then 140÷150=0.933 sp. gr. To reduce sp. gr. to B., divide 140 by the sp. gr. and subtract 130 from the quotient; the remainder will be the degree Baume. 140÷0.90 sp. gr.=155; then 155—130=25°B.

SPECIFIC VOLUME.

When a comparison of the **weight** of a Liquid to its **volume** is expressed in a standard ratio of 1, it is called the Specific Volume.

Just as specific gravity was the ratio of weight to a standard volume, so specific volume is the **volume** of a given **weight** of a Liquid compared to the **weight** of an **equal volume** of Water. In other words, it is the opposite of Specific Gravity, and is obtained by dividing the weight of a given volume of Water (1) by the weight of an equal volume of the Liquid whose specific volume is sought, thus:

Water.	Glycerin.		Specific Volume.
1,000 divided by	1,250	=	0.800

The comparison of specific gravity and specific volume, which also serves to illustrate the relation that exists between the weight and the volume of different substances, may be shown as follows:

Fill preferably a flask of a certain round number of cubic centimeters, i. e., 1000 with water. If at its maximum density (4°C.) the water will weigh 1000 Grams; if at the ordinary temperature it will weigh a little less, because the water, having expanded, a certain weighed quantity takes up more room than it does at the congealing point.

The specific gravity and the specific volume of water are therefore the same, water being the **unit** to which all liquids are compared.

As observed previously, Water is also the **weight unit** in the Metric System, the Gram being the weight of one Cubic Centimeter of Water. But water is the only simple liquid which has this property; other liquids varying greatly in **density**. As referred to under "specific gravity," some liquids are lighter, and have a **lower** specific gravity; others are heavier or denser, and have a **higher** specific gravity than Water.

If the 1,000 C. C. flask be filled with the following Liquids at the ordinary room temperature, 25°C. (77°F.) the weight in grams and their specific volumes will be respectively:

Ether 1,000 C. C.=716 Gm.: 1,000÷716=1.39 sp. volume.
Alcohol 1,000 C. C.=809 Gm.: 1,000÷809=1.23 sp. volume.
Chloroform 1,000 C. C.=1,476 Gm.: 1,000÷1,476=0.677 sp. volume.

With the Metric System specific volume has many applications. For example, when such liquids as have been referred to are sold by **measure**, in metric containers of one liter (1000 C. C.), or fractions, the weight of one liter is known at once from the sp. gr., i. e.: 1 Liter Glycerin=1,250 Grams. When sold by **weight**, the usual custom, by availing ourselves of the specific volume, calculated beforehand from the specific gravity, we have at once the measure of the liquid. For example:

1 Kilo. Glycerin=1,000 Grams; then 1,000÷1.25 sp. gr.=800 Cubic Centimeters.
1 Kilo. Chloroform; 1,000÷1.476 sp. gr.=677 Cubic Centimeters.
1 Kilo. Sulphuric Acid; 1,000÷1.826 sp. gr.=548 Cubic Centimeters.

With the old weights and measures this comparison is entirely lost, as they lack the regularity of proportion of the Metric system.

Thus the weight of 1 Pint of Glycerin is not obtained by multiplying the number of grains in the pound (av.), 7,000, with the specific gravity of the Glycerin 1.25, because one pint of water weighs more than one pound, namely, 7,274 grains at 25°C. (7,304 grs. at 4°C.), and the weight of the Glycerin is therefore 7,274×1.25=9,025 grains. The smaller denominations are equally discordant, the grain equivalents for the ounces being: Apoth. oz.=480 grs.; fl. oz.=455 grs.; av. oz.=437½ grs.

The **minim** and the **grain** are alike discordant, as will be seen by dividing the number of grains in one pound by the number of grains in one pint, which gives: 7,000÷7,274=0.96 grain equivalent to one minim instead of one grain.

Parts by Weight.

"Parts by weight" means the system by which all quantities, liquid or solid, are expressed by **weight**. It usually refers to decimal numbers, 10, 100, 1000, etc., and is therefore a **percentage** system.

Owing to this fact, it is in accord with the Metric System, and is often erroneously regarded as identical with the latter. While the metric weights, because of their **decimal** proportions, are well adapted for the quantities in which parts-by-weight may be expressed, still any other system of weights, or denominations of these, may be used; provided that the same **unit** is maintained in all the parts. Thus any quantities may be taken in the following parts-by-weight formula:

Solution of Ferric Chloride parts by weight..........................350
Alcohol parts by weight..650

For this may be taken any denomination of weight, viz.: grains, grams, drams, ounces, etc.

Liquid preparations for internal use are prescribed and administered by **measure** and not by weight, and their strengths should therefore have a **uniform** relation to the ordinary liquid measures, viz.: the minim, cubic centimeter, fl. dram, etc., upon which the dosage is based.

Thus, in the former example, only by calculating from the specific gravity can the quantity of solution of Ferric Chloride contained in these respective measures be ascertained, while by the Metric Formula, in which the liquids are measured instead of weighed, these amounts are shown at once:

TINCTURA FERRI CHLORIDI.

Solution of Ferric Chloride ....350 cc.
Alcohol, sufficient to make.....................1,000 cc.

From this it will be at once observed that a certain measure of the Tincture contains always 35 per cent. its volume of the solution, i. e.: 10 min.=3½ min. solution; 1 cc.=0.35 cc. solution. This same uniformity exists throughout all the liquid preparations of the U. S. Ph. made by measure.

Percentages.

The strength of substances and their preparations are usually expressed in **percentages** (from **per** for, **centum** one hundred) abbreviated **per cent.** and p. c.; also indicated by the sign %.

Per cent is a decimal proportion, which refers to the whole as parts of 100; just as of our money one cent is the one-hundredth and one dime the one-tenth of one dollar; and in the Metric System one centigram is the one-hundredth, one decigram the one-tenth of the Gram, and the Cubic Centimeter the **cube** of one centimeter, therefore the one-thousandth of the **cube** of the decimeter or the **Liter.**

Any percentage amount is therefore readily converted into its quantity metric terms, for example: One Kilo. of Opium contains 12.5 per cent of morphine. How much morphine does it contain? Multiply the Kilo., first reduced to Grams, by the percentage number, and then point off three figures from the right to represent the decimals for the answer: 1,000×12.5=125 Grams of morphine.

With the avoirdupois and apothcaries' weights it is necessary to reduce the quantities to the unit, the grain; thus: one pound and a half, av., 10,500×12.5=1,312.5 grains of morphine; or 10 ounces, apoth., 4,800×12.5=600 grains of morphine.

The answers in each case should be transposed to the respective highest denominations of the two systems—ounces and drams.

Percentage Solutions.

Percentage is applied to liquids, for example, to indicate the strength of acids, in anhydrous, or real acid, as in Acid Sulphuricum, U. S. Ph., 92.5 **per cent**; the strength of Ether, 96 p. c.;

Alcohol, 91 p. c., etc. Nearly all the official Solutions have their strengths expressed in percentages.

In liquid chemical products the strength is rendered in percentage by **weight**, because percentage means that all the component parts referred to in **percentage** must be compared by the same standard as the **whole**. That is, they must either **all** be **measured**, or **all** be **weighed**; if the percentage is based on **measure**, **all** the parts must also be **measured**, an operation not practicable with solids. But as there is no practical difficulty in weighing liquids, particularly on the large scale, for the purpose of attaining the greatest accuracy, this basis has been adopted for liquids which from their character are not intended to be taken internally without further preparation.

Solution of Ferric Chloride is not given internally, but the Tincture, prepared from it, is; hence the convenience of knowing its strength by **measure**. The Solution, on the other hand, is prepared by **weight**, in order that its correct specific gravity from which its percentage strength is determined, may be most easily obtained.

In pharmaceutic practice the percentage strength of solutions intended for dispensing purposes is usually referred to, as **solids by weight** and **liquids by measure.**

In the internal administration of remedies the physician is concerned as to the dose represented in the ordinary fluid measures —minim, fluidram, cubic centimeter, etc., rather than its percentage strength by weight.

In preparing solutions **extemporaneously** (as needed), therefore, the pharmacist calculates the percentage amount, say in grains, of the solid from the amount in grains of the liquid, if water, to be used and to this adds sufficient liquid to make up the solution to the required measure or volume, and not **weight,** unless so directed.

Thus, if 1 fl. oz. of a 2 p. c. solution of phenol (carbolic acid) is required, the quantities are: Water, $456 \times .02 = 9.12$ grains phenol.

Here again the uniformity and commensurability of the Metric System become readily apparent. Any percentage solution may be expressed in 1 Gram **for each per cent** in each 100 Cubic Centimeters, or 1 dcg. for 10 c.c.; 1 cg. for 1 c.c.

Thus 250 c.c. of a 4 p. c. solution of Boric Acid: $250 \times .04 = 10$ Grams Boric Acid.

All percentage solutions, whether by weight or by volume, should be prepared metrically, as it will save calculation, and prevent errors.

Every student should have access to, or should supply himself with Metric weights and measures.

IMPORTANT.

Student will answer these Questions on **letter-size** paper, **in ink,** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the Question itself, but only the number of each Question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

—— In order to insure prompt attention, all the rules of the "Important Notice" must be complied with.

THE DIRECTOR.

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1. Define Pharmacy.

2. Define Toxicology, Chemistry, Pharmacognosy.

3. What is a Pharmacopoeia? What relation does a Dispensatory bear to a Pharmacopoeia?

4. When did the present Pharmacopoeia become official? How is the present Pharmacopoeia designated?

5. What two Titles are given to every Pharmacopoeial article?

6. What is meant by Metrology?

7. What causes a substance to have Weight, and how may its Weight be determined?

8. Give some of the advantages of the Metric system of Weights and Measures.

9. What is the unit of Weight common to Troy and Avoirdupois weight?

10. What is the unit of length in the Metric system? How are the units of Weight and Liquid measure derived from it?

In the following Examples show the method of solving:

11. Convert 20 Troy ounces into Avoirdupois pounds. Convert 20 Avoirdupois ounces into Troy pounds.

12. What is the equivalent, in Litres, of 6 gallons?

13. How many mm. in 5 inches?

14. How many minims in 5 Cc? How many Cc in 4 fl. Ounces?

15. How many grains in 15 Avoirdupois Ounces? How many Grams?

16. Convert 20 Troy Ounces into Grams.

17. How many grains in one Gram? How many milligrams in one grain?

18. What is meant by Specific Gravity? What **physical** characteristic must be considered in computing the Specific Gravity of liquids?

19. What is a pycometer? A hydrometer?

20. How would you determine the Specific Gravity of a substance lighter than water? Of a substance soluble in Water?

21. The Specific Gravity of a substance being 1.3, what is its specific volume?

22. What is the equivalent in fl. ounces of 3 lbs. avoirdupois of Chloroform (s. g. 1.49)?

23. A barrel of liquid is found to weigh 320 lbs.; the barrel weighs 76 pounds. What is the net weight of the liquid?

24. If 400 Cc of Mercury (s. g. 13.55) cost $7.20, how much would 100 Grams cost?

25. How many pounds of Ether (s. g. 0.717) can be put in a can that will just hold 25 lbs. Av. of Glycerin (s. g. 1.250)?

26. A 250 Gm. pycnometer is found to contain 300 Grams of a liquid. What is the sp. gr. of the liquid? The specific volume?

27. What conditions govern the size of Drops?

28. What liquid measures are in use in the United States?

29. A cask contains 12 cubic feet; how many Gallons will it hold?

30. How many grains of Cocaine Hydrochlorate would be required for 75 Cc of a 4 per cent solution?

31. A Solution of Cocaine hydrochlorate contains 24 grains to the fluid ounce; what is its percentage strength?

32. What is the law of Archimedes?

33. How many grains of Corrosive Sublimate in one pint of one per mille solution?

34. Write in full the meaning of the following terms: 6.; 0.006; 60 Cc; 4 L.; 10 mm.

35. Also the following: dcg; cg; mg; Cong; Oct.

After the next Lecture, No. III., the subject of Inorganic Pharmacy begins. In order that the student may satisfactorily proceed with the study, he should now review the first chapters on Chemistry treating of the Properties of Matter and follow the remaining Lectures with frequent reference to a work on Chemistry.

HEAT AND ITS MANIFESTATIONS.

Heat, in its many manifestations, is a very important agent, and its study, therefore, is essential to a knowledge of the laws of pharmacy.

The theories concerning the phenomenon called heat are so closely related to those of physics and chemistry that they may be said to be the basis of both; nor is there any longer the former clear distinction between these two sciences since, according to modern theories, there is no definite separating line between chemical and physical changes.

By the term **heat** is meant that state or condition of a substance which produces in us the sensation of warmth.

Heat is a purely relative term, depending for its significance on the state or condition with which it is compared. Thus, the expression that such a substance is **hot**, means that it is warmer than substances with which it may be compared, just as that it is **cold** refers to the opposite—that it is by comparison colder than some other substance.

Heat theoretically is therefore entirely a question of comparison, as illustrated in the saying that "heat is the absence of Cold and Cold is the absence of Heat." For practical purposes the state of degree of heat is called Temperature, and is expressed arbitrarily in degrees, or measured by the Thermometer, an instrument which, as will be seen presently, is designed to measure heat by utilizing one of its principal manifestations in certain substances, viz., expansion and contraction.

Heat may be defined as that molecular force, motion or the vibration of a substance, which manifests itself by increasing the **normal** temperature; just as such molecular motion may produce other manifestations, such as Light, Magnetism, and Electricity.

One of the most common effects of heat is that it causes substances to **expand,** and consequently the lack of it, or cold, causes substances to **contract.** This is because the molecules of which all substances are composed are little balls moving freely in circles which, upon being heated, require more space for motion, just as when the heat is withdrawn these little balls or molecules slow down in their circular motion and therefore do not require so much room in which to move.

All substances are not equally affected, however, by this manifestation; thus, some solids, such as wood, are scarcely affected at all, while metals are very much expanded, as illustrated in the laying of steel railway-tracks in which allowance must be made for the expansion in hot weather.

Liquids are more influenced by heat than solids, some expanding considerably, as for example, light liquids, alcohol, ether, benzin, etc., while water is affected in an opposite direction also; that is, as it loses heat it contracts until it becomes cold enough to freeze into ice when it expands. Allowance should therefore be made for expansion in the case of all liquids contained in glass vessels in order to prevent breaking of the vessels when completely filled with liquids and when tightly stoppered and exposed to low temperature or to heat.

The ratios of expansion are designated as **linear** for Metals, **cubical** for Liquids, while for Gases the expansion is uniform, that is, all Gases expand **equally** for each degree of temperature. The expansion of gases and the various Laws bearing thereon are exceedingly important in chemistry and will be duly considered under that head.

But, as already observed, the state of Aggregation depends on the molecular condition of the substance and in such substances as may be readily made to assume one or the other of the three states, viz.: **solid, liquid** or **gaseous**; the changes from any of these states to some other state and back again to the original state are most important, and it is the processes concerned therein which constitute the principal operations in pharmacy.

Conduction of Heat.

The utilization of heat requires its absorption or **transference** from one body to another. This is effected in two ways:

(1) By conduction. (2) By radiation.

By conduction when the heat travels along communicating its force or vibration to all surrounding particles of a substance, as a bar of iron when heated at one end, a vessel containing a liquid when heat is applied to the bottom, or when the air in a chimney is heated by the fire in the furnace, and, becoming lighter, rushes upward, thus causing a draught. This is also called convection.

Solids are, as a class, better conductors than liquids, and liquids better conductors than gases, but all solids do not possess the power of conducting heat in the same degree.

Thus the Metals, which are the best heat conductors, vary widely, Silver being best, and Copper, Tin, Platinum and Bismuth inferior in the order named. Earthenware and Glass are poor conductors, but much better than Wood, which is in turn much inferior to Woolen and other fabrics, while Rubber is the poorest conductor of all.

These various substances are therefore used to effect different purposes, according as it is desired to retain the heat, when a poor conductor is used, as in wrapping Ice in a woolen cloth, or when it is desired to bring a Liquid to boil quickly, a copper or tin vessel being then employed.

For the same reason a glass vessel, when hot, should not be brought in contact with metal, stone, or other good conductors, since the latter would abstract or conduct the heat from the glass in a manner to cause the ves-

sel to break. Counter tops should, therefore, consist of wood or other poor conducting material.

Liquids, while not especially good heat conductors, absorb heat uniformly, and also give it off readily, while gases are the poorest conductors of the three kinds of matter. In cold countries this property of gases is utilized in keeping houses warm by means of double windows; the air between, acting as a poor conductor, retains the heat of the interior of the rooms.

Radiation.

Another method of transference of heat is by radiation, or the conduction of the heat from heated objects through the atmosphere, as the heat from the combustion in a stove.

The principal source of heat is that derived from the Sun; that of the Earth and other planets being no doubt the result of molecular motion or energy. The heat of the Sun's rays is probably molecular energy or force transferred through some medium called Ether which is supposed to fill all the planetary space. The Sun's rays are propagated throughout this ether-space in Waves assuming various forms and different manifestations. Thus, some waves are dark and have heat effects, others are light and produce light and heat, while still others produce only chemical effects; to these belong the actinic rays, Roentgen rays or X rays.

Heat is also produced by Electricity and magnetic force, since these are also forms of molecular motion or vibration. A strong current forced into an inadequate conductor in large volume, such as copper wire, possesses great physical energy or power, or, under certain conditions, as when expended in a non-conducting material in a vacuum, produces incandescence and thus furnishes illumination or electric light.

Pharmaceutical Uses of Heat.

The principal source of heat for pharmacal operations is combustion. In the burning of any inflammable substance, such as wood, coal, coke, petroleum, alcohol and coal gas, heat is evolved as the result of chemical action or decomposition.

Coal gas is the most convenient and, when available, the cheapest, although petroleum and alcohol and, of course, the surplus heat obtained from combustion in stoves and especially steam radiators, are most economical and satisfactory. When coal-gas is burned under ordinary conditions it leaves a residue of black soot, which must be avoided when this gas is used for heating; this is effected by letting the gas be mixed with air before it is ignited which insures complete combustion—the air, decomposed by the heat, produces such intense heat as to cause the complete burning up of the carbon which forms the soot.

The "Bunsen burner" is constructed on this principle. It consists of a tube provided with a vent at the base, immediately above where the gas enters, for the admission of Air. By means of a movable ring or collar, this vent or opening may be partially closed and the amount of air admitted through the opening, as determined by the suction of the gas when turned on in the tube, may be regulated and the flame be thus controlled.

All gas-stoves are constructed on this principle; care should be taken that the gas be not ignited before the mixture of gas and air has expelled the air in the tube, as this would cause an explosion and ignite the gas at

BUNSEN BURNERS SHOWING FLAME.
PROPERLY REGULATED. IMPROPERLY REGULATED.

the vent and thus cause damage through too great expansion of the tube by the heat.

For burning alcohol, lamps and blast lamps are used, and for petroleum, stoves. To increase the heat the flame is sometimes artificially fed with a current or blast of air by means of a blow-pipe; and for the great heat of a Furnace required for certain metallurigcal operations, Bellows are used.

Utensils and Apparatus.

For most chemical operations requiring heat, the vessels used are of glass. That they may withstand the heat their walls are as thin as practicable, in order that they may quickly and uniformly expand. The thinner the glass, the more quickly will it expand and the less the liability to fracture; on the other hand, constructed of very thin glass, they are exceedingly fragile, and must be handled gently or they will break.

Test tubes are made of glass so thin that a tube filled with cold water may be placed directly in the flame without breaking.

Beakers and Flasks are made of somewhat thicker glass and should therefore be heated more gradually by first warming them.

For pharmaceutical operations glazed earthenware dishes are usually preferred; also enameled metal-ware. The most commonly employed are:

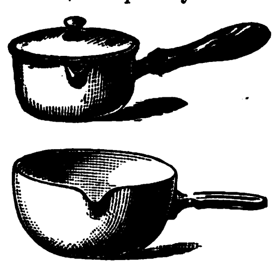
(1) Evaporating dishes or porcelain Capsules, and (2) Casseroles.

The casserole is deeper than the capsule and is provided with a handle and sometimes also a cover. While these vessels are durable, they may easily crack by applying the flame too suddenly or by heating them before the substance to be heated is put into them. These vessels, when hot, should never be placed directly over a cold surface, especially if it be of good heat-conducting material such as metal, but on a poor heat-conducting body, preferably on rings of rubber, straw-mats or rings called Grommets.

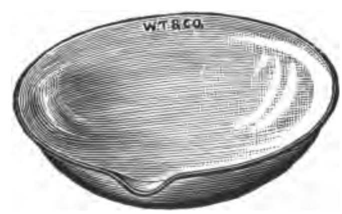
Corks should always be manipulated dry, but when used, they should, as a rule, be wet. When "squeezed" the cork should be put its entire length in the cork-press, otherwise it may crack. Perforations may be made in a cork with a rat-tail file, or with a cork-borer, and the size of the cork may also be reduced by rubbing it with sand-paper.

Rubber-stoppers may be cut with a knife moistened with Alcohol; perforations in these stoppers can be made only with the cork-borer wetted with alcohol.

Glass-tubing, to be cut, should be simply "nicked" with a triangular file. It is then quickly bent or tapped and the sharp edges of the pieces



CASSEROLES.



CAPSULE OR EVAPORATING DISH.

rounded by melting in a flame. To bend tubing, it should be held in the flame in such a position that the softened part will form an angle or elbow of its own weight.

To make a capillary tube: heat the tubing until soft; then draw it out straight until it separates. When cold break off the tip as to obtain an opening not larger than a needle point. Glass may be filed, like metal, by moistening the file with a solution of camphor in chloroform.

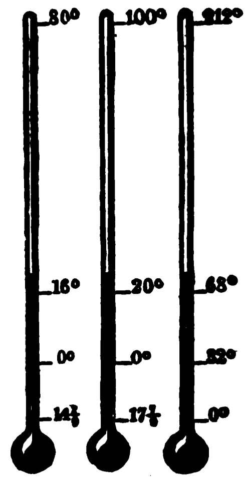
Thermometers.

The extent of the expansion or contraction of a given substance caused by the absorption or abstraction of heat, expressed in parts or degrees, constitutes the usual method for estimating the degree of sensible heat imparted by a body—in other words, the degree of its temperature.

Since the expansion and contraction in volume are constant with the changes in temperature, the extent of variation may be best determined by the substances usually employed—mercury, because of its regular expansion, and because it boils only at a very high temperature; and alcohol, because it does not solidify except by extraordinary cold.

Thermometers (from Thermæ, Gr., heat, and metron, Gr., measure) are instruments made of a glass tube, with a bulb at one end filled with mercury or alcohol (colored red), the tube

BOILING IN TEST TUBE.



R. C. F.
THERMOMETERS COMPARED.

being attached to a graduated scale; the mercury rises and falls in the tube as its volume is increased by heat or decreased by cold.

Three different standards have been adopted for thermometers, termed respectively: Reaumur, Celsi, and Fahrenheit.

In Reaumur's Scale, zero is at the freezing point of water, and 80° the point at which water boils.

In the Celsi or Centigrade (from Celsius, its discoverer), the zero point is also that of freezing water, but the boiling point is fixed at 100°.

In Fahrenheit's, the freezing point of water is at 32°, and that of boiling water is at 212°; hence the number of degrees between these two standard points in this theremometric scale is 180, instead of 80° and 100° in Reaumur and Celsi respectively. The point 32°, taken for the freezing point of water in Fahrenheit, instead of 0 as in the other scales, is explained by the fact that zero was the lowest degree of cold (obtained from

a mixture of snow and ammonium chloride) known up to the time of the construction of the Fahrenheit scale.

The Fahrenheit theremometer is almost exclusively used in the United States, except for scientific use. The Celsi is becoming the standard authority in scientific work, owing to its centesimal scale being in harmony with the metric system of weights and measures and is given the preference in the U. S. Ph. It will eventually supercede the other scales. Reaumur's is chiefly employed in Germany and is therefore extensively in the chemical industries.

In converting the degrees of one scale into either of the others, we must find a number which is divisible into the three respective numbers: 80, 100, and 180, without any fraction. Such a number is 20, and the quotients obtained, viz.: 4, 5,, and 9, express the number of degrees in each scale equivalent to the same degree of temperature. In Fahrenheit, the 32° between freezing-point and zero must invariably be added when the degrees of other scales are converted into it, after the degrees are made equivalent to the proportion just named.

In reducing Fahrenheit to Celsi and Reaumur, the 32° are first subtracted, and then the remaining degrees are reduced to the equivalent proportions.

Examples.—To convert 15 Celsi degrees to those of Fahrenheit, multiply by 9, divide by 5, and add 32; equal to 59°F. To reduce 40 Fahrenheit degrees to those of Celsi, subtract 32, multiply by 5, and divide by 9; equal to 4.44°C. To reduce F. to R., subtract 32, multiply by 4 and divide by 9. [For table of Thermometric Equivalents, see U. S. Pharmacopœia.]

To express temperatures below 0 the number of degrees is prefixed by the minus sign, thus: —17.77°C (=1°F).

Higher temperatures than 300° or 400°C. are measured by the pyrometer (from **pyr**, Gr., fire) an instrument in which the degrees are expressed by the expansion of a metallic rod (platinum). The following terms are used to designate temperatures in the working of metals: Cherry red, 500°C.; red hat, 700°C., and white heat, 1000°C.

Latent Heat.

From the fact that the temperature of a solid ceases to rise while it is melting, even though heat be still applied to it, we readily see that much heat must disappear in the process. This is said to become **latent** (from latere, Lat., conceal). Latent heat differs physically from free or **sensible** heat, in that its presence **cannot be determined by the senses or by the thermometer.**

When, however, certain chemical actions take place, or the state of aggregation changes from a **gaseous** substance to a

liquid, or from a liquid to a **solid,** the **latent** heat so-called is rendered sensible.

We may regard the particles of any body as being subjected to two opposing forces—**cohesion,** which tends to draw them more closely together—and **heat,** which tends to drive them farther apart.

If a solid, Ice for example, be heated at a given temperature the particles, driven apart, resolve the substance into a **liquid** state; Water, in which by continued absorption of heat the cohesion is overcome and the particles fly apart in the form of **vapor.** When the source of heat is removed, and that already acquired by the substance has been imparted to surrounding objects, cohesion again comes into play and the substance assumes the **liquid** state or if the temperature be reduced sufficiently low, the **solid** state.

The heat absorbed by the water is expended in forming it into vapor; when such vapor comes in contact with a colder body, such as air currents, the latent heat is abstracted and the water resumes its original liquid state. When the vapor is confined by the pressure of a steam boiler it may be heated to a temperature considerably higher than the boiling-point, and thus possesses still greater heating power.

One cubic inch of water by boiling is converted into about 1,700 cubic inches, or nearly one cubic fot, of steam, and in the mere conversion of a cubic inch of water at 100°C. into steam at the same temperature an amount of force is exerted which is equivalent to lifting about 27,000 pounds one foot high.

Steam, as a source of heat, contains 520°C. of latent heat. By contact with a cold surface it is condensed to the liquid form and this heat is given out. Theoretically, steam in the act of condensing will raise the temperature of nearly ten times its weight of water 55°C. Twenty pounds of steam condensed in 200 pounds of water at 44°C. will raise the temperature of the water to 100°C. if no loss is sustained.

Water is thus utilized as a medium for the tranference, or as a carrier, of heat, as illustrated in a Steam-heating plant. The water takes up the heat from the burning coal, the energy resulting from the combustion of the fuel is imparted to the water, which as steam forces itself through great lengths of pipe, or radiators, which being made of good heat-conducting materials, give off the heat to surrounding objects—the colder atmosphere—until finally when all the heat is abstracted from the steam, it returns to its original liquid state. By a reversal of the process cold may be produced, as when water in the act of perspiration changes from the liquid state to vapor by the heat of the body, thus reducing the temperature, or when used for sprinkling heated pavements. When a gas like Ammonia is compressed into a liquid and then released in metallic conduits it will absorb heat from the surroundings with such avidity as to produce cold. Upon this principle the Ice-machine is constructed.

Vaporization.

When a solid or liquid body changes into the gaseous form it is said to undergo vaporization. This change is often effected by a relatively low temperature, when the result is called **vapor.** Higher temperatures drive the molecules apart to their greatest distances, when the result of the change is termed **gas.**

Vaporization depends upon the abstraction of heat from surrounding bodies, as in the transformation of water into vapor, by absorption of heat from the Earth. This heat, rendered latent in converting the liquid into vapor, is abstracted by the colder atmosphere in the upper air-currents and the vapor is transformed into its original liquid state—water, or if exposed to a **low** temperature it congeals or freezes and then forms snow. This natural phenomenon of rain is in fact the best practical illustration, not only of the effects of heat in changing the state of aggregation, but also in demonstrating the various processes depending thereon.

Upon the general process of vaporization the following pharmacal operations are dependent:

Evaporation.

Evaporation is the process of vaporization applied to a liquid for the removal of liquid, either partly to reduce its bulk or volume—called **concentration**—or its entire removal, so as to leave a solid **residue.**

It may be either (1) **Spontaneous,** that is, without artificial heat or (2) requiring the application of heat. Only the latter will now be considered.

In Evaporating a Substance it should be placed in a shallow vessel and frequently stirred.

The greater the extent of the surface of the vaporizable substance to the air and the source of heat the greater and more rapid the rate of evaporation.

The best illustration of this principle in practice is the method employed in evaporating thick or viscid liquids, such as the so-called Solid Extracts and solutions from which the so-called Scaled Salts of Iron are prepared. These are first evaporated to a syrupy consistence and then spread in thin layers on glass-plates in order to remove the remaining liquid.

Stirring or agitation favors evaporation by renewing the air in contact with the surface of the liquid.

The air above a vaporizable liquid soon becomes charged with vapor, and the evaporating process goes on slowly unless the air be renewed; the more rapid the removal of the saturated air the more rapid will be the evaporation.

Partly on this principle and partly on the principle that the

boiling point of liquids is lowered as the atmospheric pressure on the surface is reduced, the process of **evaporation in vacuo** is performed. While under the ordinary atmospheric pressure of 15 lbs. to the square inch, water boils at 100°C. (212°F.), when heated in a closed vessel and the air above its surface exhausted, it boils at 27° or 32°C. (80° or 90°F.) below the usual temperature, or about 55°C. (132°F.). The process also has the advantage that it permits rapid evaporation in a comparatively low temperature.

The following considerations should also be observed in conducting the process of evaporation:

(1) The evaporating dishes should be made of material from which the residue, if solid, may be removed without contamination. For this reason porcelain or enameled dishes are to be preferred to those of soft metal, such as copper.

(2) The heat should be carefully regulated as its source, to avoid overheating the substances. **Vegetable** principles are much more easily imparied or destroyed by heat than **inorganic** or mineral substances; these latter, when in solution, do not require any special precaution, since they may usually be subjected to considerable heat without undergoing decomposition.

(3) In evaporating a substance, the highest degree of temperature to which it may be exposed without injury must be known, and the source of heat employed accordingly. The so-called Baths are therefore employed in evaporation, as by this means the temperature may be easily regulated and kept within proper limits.

Baths.

The principle upon which baths are constructed is, **that all matter gives out heat to surrounding matter.**

When, therefore, a liquid, such as Water, is heated, it communicates its heat to any substance with which it comes in contact, until both have the same temperature.

For the Baths, or **Media,** as they are called, any substance may be employed, but the following are those in use in pharmacy:

Water-Bath.—Water boils at 100°C. (212°F.) and through its use in the form of a bath any substance may therefore be heated to nearly this same temperature.

It consists of two vessels—one fitting within the other in such a manner that a space of greater or less extent is left between them. This space is nearly filled with water, and the substance to be evaporatd is placed in the inner vessel. In practice this boiling temperature cannot be quite attained, and if the substance be one liable to decomposition at any higher temperature, the process becomes a safeguard against such an occurrence. The Method also admits of very gradual and even application of heat.

Steam-Bath.—The use of steam heat in certain forms of evaporation is a great convenience, since it affords a **range** of temperature proportionate to its **pressure**, or to the pressure which the vessel is calculated to sustain.

The vessel or apparatus for a steam bath consists of two pans, riveted together at the upper edge—jacketed—having an inlet-pipe to admit the steam into the space between the two pans just below the point where they were joined, and an outlet-pipe at the bottom, allowing the escape of the condensed steam or water. Both pipes must be provided with stop-cocks to regulate respectively the inflow and escape of the steam.

CONTINUOUS WATER BATH.

WATER BATHS.

Steam may also be employed for heating purposes, but not for evaporation, without being confined, called "live-steam," by placing the vessel, containing the substance to be heated, loosely into another vessel so that it rests upon the rim of the latter, into which the steam is admitted.

The term "gentle heat" the U. S. Ph. defines as meaning any temperature between 32° and 38°C. (90 and 100°F.). Other terms occasionally employed are "moderate heat" 55° to 70°C. (130 to 165°F.) and "temperate heat" 15°C. (59°F.).

Saline Baths.—Saturated solutions of various salts, in order to be brought to the boiling point, require a greater amount of heat than does water. For example, the boiling point of a saturated solution of sodium chloride is 108°C. (227°F.); sodium borate (borax) 105°C. (222°F.); ammonium chloride, 144°C. (237°F.); potassium nitrate, 115°C. (240°F.); sodium acetate, 124°C. (256°F.), and calcium chloride, 179°C. (354°F.).

The use of these baths is indicated when it is desired to heat a substance a few degrees higher than can be done by the water-bath, and also when a very regular heat is desired, since the temperature in these baths, under a uniform heat, does not change so long as the water is replenished sufficiently to hold all but a small portion of the salt in solution.

When it is desired to heat a substance above the temperature attained by the Water or Saline Baths, and yet limit the heat to a temperature between 150 and 300°C. (300° and 572°F.), various substances boiling at a high temperature have been employed. Of these the fixed Oils and Glycerin are objectionable owing to their decomposition.

The Petrolatum or Paraffin Bath should be used whenever temperatures between the degrees mentioned are wanted.

The Sand Bath is employed when an extreme heat is desired, but when a naked fire would not yield a constant or regular temperature.

It consists simply of a layer of dry sand placed in a shallow-iron dish, in which the vessel to be heated is imbeded. A comparatively thin layer of sand will be sufficient to equalize the heat and prevent a sudden rise in the temperature, which might result in fracturing the vessel or injuring the product.

Protective media used are: wire-gauze, asbestos plates, etc. These should always be employed to protect glass-vessels against the naked flame.

Boiling.

When vaporization occurs only on the surface of a liquid the liquid undergoes evaporation, but when vapor is formed throughout the liquid, the liquid is said to boil.

Water, on attaining the temperature of 100°C. (212°F.), enters into a state of **ebullition**; a large number of bubbles of vapor, or steam, are produced in the part of the vessel exposed to the heat, which rise through the liquid, violently agitating it as they burst. This is termed **boiling.**

The point at which this ebullition commences is that at which the tension of the vapor becomes sufficient to overcome the pressure of the atmosphere; hence, if this pressure be increased the boiling point will be raised. Thus, the boiling point of water is 100°C. at 30 in. barometer; when the mercury column in the barometer falls, indicating diminished pressure of the air, the water boils at a lower temperature. This also explains how liquids may be caused to boil at very low temperature, by the removal of all pressure, as boiling in a vacuum.

The determination of the boiling point of liquids is very important, since boiling discloses a physical property usually dependent upon the chemical constitution of the liquid, and therefore frequently is an index to its identity, strength or purity.

For this reason the boiling point is one of the characteristics of liquids, and is usually given in the U. S. Ph. directly after that of the specific gravity and solubilities.

It varies considerably, from that of Ether at 35.5°C. (96°F.) to that of Sulphuric Acid at 338°C. (640°F.).

To determine the boiling point the liquid is brought to boiling in a test-tube or other proper vessel, then inserting a bulb thermometer in the vapor just above the surface of the liquid for a few minutes; the degree of heat indicated by the mercury column after it has become stationery is the boiling point of the liquid.

In vessels composed of materials which are **good conductors** of heat, **e. g.**, metals, a liquid can be brought to the boiling point much more quickly than in porcelain, earthen or glass vessels, which are **poor** conductors of heat. Heat is more readily absorbed by substances presenting dark and rough surfaces than by those having light-colored and smooth exteriors. A liquid is therefore more quickly heated in a vessel of unpolished metal than in one having a smooth or brightly-polished surface.

BOILING POINT DETERMINATION.

BOILING IN A VACUUM.

It is often desirable to use hot water in cleaning glass bottles, garduated measures, or other glass dishes. This operation, unless conducted intelligently, is almost certain to result in disaster. A simple and perfectly safe method is first to wet thoroughly, the interior walls of the vessel with cold water; then boiling hot water may be poured into it without danger of fracture.

Boiling as a Preservative.

Boiling is of value as a preservative.

Liquids containing albuminous constituents which may be prone to fermentation are preserved by boiling.

In subjecting such liquids as, for example, vinegar of squill,

to boiling, the albuminous principles are coagulated and may be removed by filtration of the liquid.

Bacteria, which are often present in liquids and cause fermentation, are also destroyed by boiling heat. Yeast and certain micro-organisms are destroyed by maintaining the article containing them at a temperature of from 60° to 65° C. (140° F. to 150° F). This is the process called Pasteurization, largely employed in the preservation of fruits, fruit-juices, malt and other beverages, the constituents of which would be more or less impaired by being subjected to a higher temperature.

In boiling without pressure in an open vessel the temperature of a liquid can never be raised above its boiling point, as all the surplus heat received is employed in evaporating the water, except under the conditions above noted. When a closed vessel is employed, the pressure may be increased and a much higher temperature attained.

Advantage is taken of this fact in pharmacy, when boiling water is desired quickly, as, for example, in making decoctions or infusions. The vessel used for heating the water in such cases should be covered.

Sterilization.

Pathogenic or Disease-Breeding Bacteria, or Germs causing infection, are destroyed only by a boiling temperature. Subjecting a substance, therefore, to boiling, and maintaining the temperature for a short time, from ten to thirty minutes, is the process of Sterilization, so termed because, if effectively performed, the product will be **sterile**, that is, free from bacteria.

There are some bacteria—the so-called spore-bearing bacteria of edema, tetanus, anthrax, etc.—which while they are themselves destroyed by the boiling heat, leave spores which survive. To destroy these it is necessary to subject the substance, after an interval of twenty-four hours, to a second boiling operation, and even a third. This is called re-sterilization, double or fractional, and insures **absolute sterility.**

The value of sterilization as a pharmacal process, and its importance in medicine, is not fully recognized.

All preparations intended for external use should be sterile as far as practicable. Solutions for hypodermic or subcutaneous injections, collyria, gargles, lotions, injections, sprays, antiseptic solutions generally, surgical dressings, gauze, cotton, etc., should not only be sterilized, but should be dispensed sterile and in a manner to keep sterile as long as possible, or as may be required.

There is generally an exaggerated idea as to the application of the process and to the apparatus required. It must be remembered that sterile means **absolutely clean** and **aseptic**, free from germs. The vessels, containers and the surroundings must be clean and the agent to clean them is

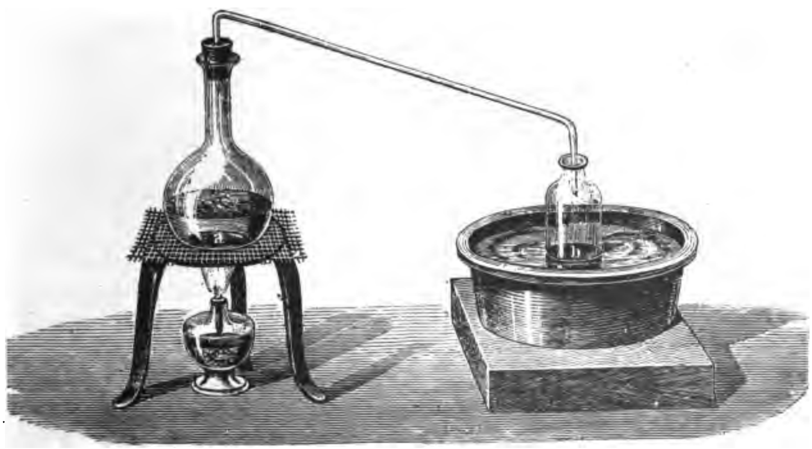
boiling water. To sterilize, therefore, plenty of boiling water should first be used to wash up everything employed in the operation,—to scald out the vessels and especially the containers. The latter should then be carefully covered by sterile material; in the case of bottles, they should be stoppered with sterile glass-stoppers, not corks.

In preparing a solution, for example, of atropine sulphate, the desired quantity of water is brought to boiling in a sterile flask, the heat removed, and the required amount of atropine sulphate dropped into the hot water, and the flask quickly stoppered. A small filter is placed in a small sterile funnel and filled with boiling water, allowed to drain, and inserted in the sterile container. The solution is now poured into the funnel, which is then covered, and when the liquid has filtered through, the container is stoppered and dispensed.

Distilled Water, if properly prepared, is **sterile,** but upon exposure it quickly absorbs bacteria and other impurities from the Air and thus becomes unfit for use. The employment of distilled water does not therefore insure **sterile** solutions unless it is freshly prepared and is kept in a manner to preserve its **sterility.**

Distillation.

Distillation is the process whereby a liquid substance is obtained or separated from other substances by means of **evaporation and condensation.** The product is termed a **distillate.**



DISTILLATION FROM FLASK.

The vaporization of a liquid for the purpose of distillation is usually conducted in a vessel especially constructed for distilling, termed a **still.**

The Still consists essentially of a **retort** and a **condenser.**

The retort, containing the liquid to be distilled, commonly consists of a vessel rounded below and contracted into a neck above. The neck or outlet-pipe should, in order to facilitate the

escape of the vapors into the condenser, gradually curve downward.

The simplest form of distillation is effected by the use of a Flask, fitted with glass-tubing, but this is adapted only to highly volatile liquids and for operations on a small scale.

The distillation of acid liquids must be conducted in **glass** retorts and may be successfully performed without the use of other apparatus than a Retort and a Receiver.

The vapor may be condensed in the neck of the retort by covering its entire length with thick cloth, kept constantly cold by the application of ice-cold water, so that every particle of vapor be condensed, before it reaches the opening which dips into the receiver, which should be surrounded with ice. By this method explosions due to incondensable gases may be avoided.

RETORT AND RECEIVER.

FUNNEL TUBE.

Retorts are either **plain** (made in one piece with one opening at the end of the elongated neck), or are furnished with a small aperture at the neck provided with a ground-glass stopper, when they are called **tubulated.** The purpose of this aperture (tubulure) is to enable the operator to introduce fresh quantities of the substance to be distilled and for the insertion of a thermometer.

In retorts not tubulated, this procedure is very difficult and inconvenient, because the liquid cannot be poured into the retort without placing it in an upright position, thus disarranging the whole apparatus. By means of a funnel-tube (a glass tube with a bell-shaped end) the retort can easily be filled or replenished through the tubulure.

The Adapter is a short tube, sufficiently wide at one end to receive the end of the still or retort, gradually tapering to a width which admits it into the neck of the receiver.

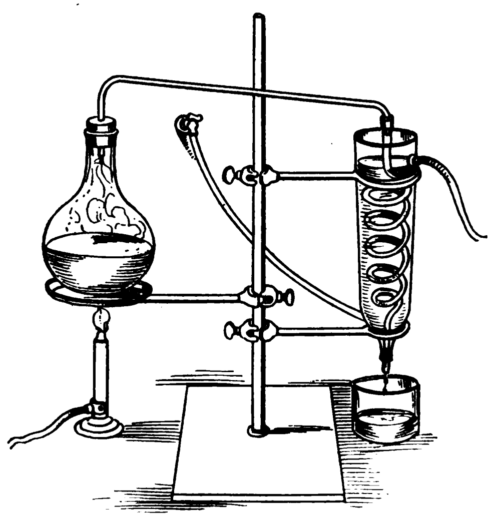
Condensation.

The vapor formed in evaporation by exposure to a cold temperature is converted into a liquid—**condensed.**

It is necessary to use artificial means for condensing the vapors, since the effect of cold air alone is too slow and unreliable; this is effected by means of the **condenser.**

A condenser is a tube or coil of considerable length attached to the neck of the still, for carrying the vapor through a cold substance—usually water—and when condensed into liquid form to convey it to the receiving vessel.

"PHOENIX" STILL.



DISTILLATION WITH WORM CONDENSER.

The usual forms of condensers are:

The worm, which consists of a coil of tubing, generally of copper or earthenware pipe, but sometimes of glass, placed in a tub or jacket of running water, and

Liebig's Condenser, which consists of two tubes of unequal diameter, fitted one within the other, the intervening space being filled with cold water.

As in evaporation, the greater the surface to which the vapor is exposed, the greater the condensation. This principle has been taken advantage of in the construction of various condensers.

One of the most effective condensers is that known as Mitscherlisch's, which consists of a double cylinder surrounded by cold water.

Fractional Distillation is the process of distillation applied to the separation of two or more liquids having different boiling points.

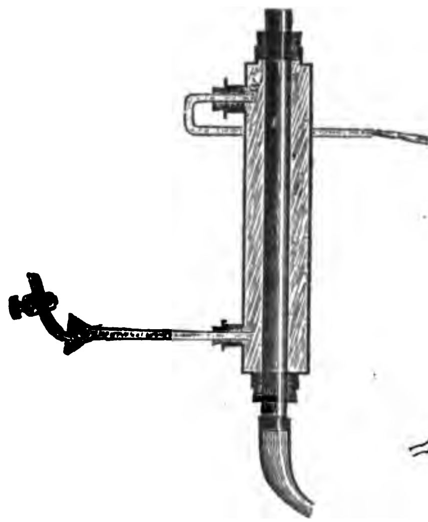
The method usually employed in this process is to insert a thermometer in the boiling liquid, and collect the distillate in different vessels as it comes over at different temperatures. The separation may also be effected by condensing the vapor in a series of receivers exposed to different temperatures.

In pharmacy, mixtures of Ether, Alcohol and Water are thus separated, owing to the great differences in their boiling points (or temperatures for vaporization) and the corresponding differences in temperature necessary for condensation. In the arts fractional distillation is largely applied to Coal-Tar Oils, Petroleum, etc.

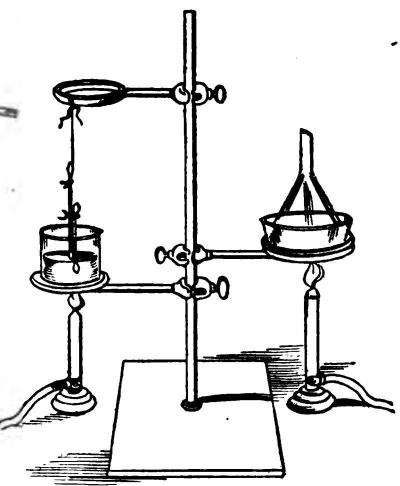
Pharmaceutical Stills.

The distillatory apparatus best adapted for pharmacal purposes are made of metal, preferably tinned copper.

In the oldest form of these, the condensation is effected by



LIEBIG'S CONDENSER.



MELTING POINT DETERMINATION. SUBLIMATION.

cold water contained in a jacketed top, surmounting the boiler and the pan containing the liquid to be distilled, which together constitute a water-bath. The top is rendered vapor-tight by a water-joint, but owing to the evaporation of the water, the joint is preferably made of some non-vaporizable substance, such as Glycerin, or Petrolatum. The most common and cheapest of this style of Still is the "Phœnix," made by a Philadelphia firm.

In conducting the process of distillation the following general rules should be observed:

(1) The apparatus must be vapor-tight. Since the object of the operation is to recover the volatile portion, any loss of vapor will necessarily reduce the quantity of the product—the distillate.

(2) The condensation must be complete. There must be an abundant supply of cold water around the condensing pipe, sufficient to condense all the vapor, otherwise loss will result. The water surrounding the vapor in the condenser should always be renewed as soon as it becomes warm.

(3) The still should never be filled more than two-thirds full of the liquid to be distilled, since otherwise it is liable to foam and boil over. Foaming may be avoided by covering the pan with a piece of coarse, wet cloth, permitting its edges to rest on the flange and when compressed making a vapor-tight joint.

Sublimation is the process of distillation applied to solid substances, or more correctly, the process whereby vapor is condensed to a **solid.**

Substances easily volatilized, such as camphor, are separated from less volatile substances and obtained from their crude state or refined by **sublimation.** The product is said to have been **sublimed** and it is sometimes called a **sublimate** (corrosive sublimate).

Inorganic substances, such as iodine, sulphur, mercury, etc., are obtained in a pure form by sublimation. Mixtures of different substances or chemical compounds may often be separated by means of sublimation.

The object of sublimation is the separation of volatile from less volatile or non-volatile solids. It is effected by the use of a retort in condensing the vapor in an air chamber; for smaller operations, a funnel inverted over a capsule so that the rim rests well within the capsule may be employed. Paper cones may also be used in the same manner.

Dry or **Destructive Distillation** differs from ordinary distillation in that it is a process involving chemical changes for the production of gases, liquids, or solids from solid substance, such as wood and coal.

Effects of Heat.

Fusion.—When the state of aggregation in substances is changed from solid to liquid by the absorption of heat, the liquefaction is termed **fusion** or **melting.**

The melting or **fusing point** of a substance is the temperature at which it changes from the solid to the liquid condition. The fusing point is very different for different substances, some liquefying at a very low, others at a very high temperature; and others still, like carbon, resist the highest temperature we are able to command. These are said to be **infusible.**

The temperature at which fusion commences is constant for any substance so long as the pressure remains constant; and from the time that fusion commences the temperature remains stationary until the whole of the substance is melted.

Some substances, as iron and wax, soften gradually before they actually fuse, while others, as lead and copper, melt without softening. In the case of iron, great advantage is taken of this property, as by means of it the blacksmith can weld different pieces together, or mould them into any desired shape.

In the melting of fats, wax, resin, and similar easily fusible substances liable to injury by heat, this law has a practical bearing, viz., that no injury by exposure of the substance to heat can result until the fusion or liquefaction is complete.

Thus, in melting a substance from which a Cerate is composed, the vessel may be exposed to considerable heat without injury to the substance, so long as any portion remains unmelted. As soon as fusion is completed, however, the heat must be carefully regulated (or its source removed), since the temperature will now steadily rise if heat be applied.

The kind of vessels used in the process of fusion depends upon the chemical nature of the substance to be melted, and the degree of heat necessary for its liquefaction. For higher temperatures **crucibles** are employed.

In pharmacy the process of fusion is mostly applied to the production of Cerates, Ointments, Plasters and similar preparations composed of substances requiring a temperature usually below 100°C. (212°F.).

The melting point of a substance, similarly to the specific gravity and boiling point of liquids, is one of the characteristics whereby the identity, etc., may be disclosed, and is therefore often referred to in the U. S. Ph. (Refer to the melting points of Wax, etc.)

To determine the melting point, a small quantity of the substance is introduced into a capillary tube. The tube is attached to a thermometer and immersed in water contained in a Beaker and heat applied. When the heat of the water causes the substance in the tube to liquefy, the temperature degree as observed in the thermometer is the melting point of the substance.

Deliquescence is the property which certain inorganic substances possess to absorb moisture from the air and gradually pass into the liquid condition.

Potassium carbonate is an example of a substance which possesses this property in a high degree. Substances of this kind should be carefully protected from the atmosphere in well-covered cans or tightly-stoppered bottles, and, if possible, in a cool, dry place.

The term **hygroscopic** is applied to solids which attract moisture, but which, owing to their inferior solubility, do not pass into the liquid condition. Examples of this kind occur in many powdered extracts.

Chemical Effects of Heat.

Among the important effects of heat are its **chemical** effects. Heat causes a vibratory motion of the molecules of a compound substance. When the temperature is increased this motion may at last become so great as to cause the constituent elements to move out of the spheres of their atomic attractions and thus cause decomposition of the substance.

Heat is one of the most useful agents for bringing about decomposition. Being a repellant force, and the repellant power increasing as the temperature rises, it is probable that if we could command a sufficiently high temperature even the most stable compounds could be separated into their elements.

The principal chemical effects of heat are the following:

Calcination, which consists in driving off volatile matter in the form of gas from solid substances by heat. The residue is usually left in the form of a friable powder, which is said to be **calcined.**

Calcination is used chiefly to expel Carbon Dioxide from its compounds (the carbonates). For example, when Calcium and Magnesium Carbonates are strongly heated, carbon dioxide and water escape into the atmosphere, and Lime and Magnesia, respectively, are left behind.

Sublimation may be regarded as the reverse of calcination, being, as already observed, a process for separating a volatile solid substance from one not volatile, and differs from it in that the volatile portion is the product desired.

Ignition is a term applied to the method of testing chemical substances by heating them to redness according to Pharmacopœial requirements.

Deflagration is a process seldom employed in pharmacy. It consists in heating one inorganic substance with another capable of yielding Oxygen, resulting in decomposition and the formation of a new compound.

Oxidation is the union of substances with Oxygen producing **oxides.** This process is usually favored by heat, moisture and division of the substance, as in the formation of **rust** from iron, copper, etc.

Some elements: Phosphorus, Potassium, Sodium, etc., combine with Oxygen at the ordinary temperature; other substances, as Charcoal, require a very high heat.

Reduction is the process whereby Oxides or Compounds containing Oxygen are deprived of their oxygen by chemical action or the use of heat. The heating of metallic oxides, such as Red Oxide of Mercury, or the "roasting" of ores to obtain their metals, are examples.

The different stages of chemical effects of heat on **organic**

substances are dependent upon the degree of heat, or combustion, to which the substances are subjected.

Thus, by applying heat to a vegetable substance, it at first becomes desiccated, then **roasted**; by increasing the heat it **chars** or "coals," if air is excluded, and finally by elevated temperature and in contact with air it "burns."

The following are the principal of these processes:

Torrefaction, or "Roasting," consists in scorching or parching organic substances to change or modify certain constituents without impairing the principles of the most value in the substance so treated.

The roasting of Coffee is a familiar example, in which the undesirable constituents are so modified as to give aroma to the berry without deterioration of the active principles, caffeine and caffeotannic acid.

Carbonization is the process of reducing to coal by heating organic substances until all volatile matter is expelled, air being excluded. The substance is said to be "charred."

Incineration, or "Burning," is the union of oxygen with the elements of an organic substance by the application of heat, resulting in the production of flame and residue, termed **ash.**

Desiccation.

The process of vaporization conducted as an operation of evaporation applied to solid organic substance is termed **Desiccation.** When applied to solid inorganic substances it is called **Exsiccation.**

Crude substances obtained from the vegetable and animal kingdoms are usually dried, or desiccated, before they can be utilized in medicine—as their bulk is by this means reduced, they are more easily preserved and their comminution is greatly facilitated.

As is well known, all organic matter contains water, which, at a favorable temperature, from 32° to 49°C. (90° to 120°F.), facilitates changes in the principles usually present, resulting in decomposition of the substance, and frequently impairing its value.

Albumen, gum, sugar, starch, etc., are substances found in vegetable drugs, which, with moisture and exposure to warm temperatures, undergo putrefactive or fermentative changes. The presence of moisture and vegetable acids similarly causes the formation of fungoid growth (mold), which is detrimental to the substance, frequently diminishing its active principles, and hence impairing its medicinal value.

In depriving the substance of its moisture, by evaporation of the water, we therefore remove the principal cause of decomposition, i. e., water. This process is termed **drying.**

While the most favorable temperature for decomposition is 38°C. (100°F.), albumen coagulates at 49°C. (120°F.) and at 60°C. (140°F.) and above, most of the principles promoting change in organic substances become so modified by the heat as to permit no deterioration of the drugs, which are then designated as **cured.**

DRYING CLOSET.

Since a temperature above 32°C. (90°F.) cannot usually be obtained in temperate climate from the sun's rays alone, the drying of the drugs is generally effected by artificial heat, such as hot air or steam.

On a large scale, drying-rooms are used, heated by hot air or steam and furnished with large shelves upon which the trays containing the substance to be dried are placed. It is necessary to admit fresh air in such drying closets at the bottom and provide an exit at the top for the escape of the air, which has become saturated with the moisture of the drugs in the form of vapor (see illustration). Unless so arranged that a current of air transverses the drying-room, acting as a carrying agent of the water, the evaporation will cease as soon as the air confined in the chamber becomes saturated with vapor.

The drying of chemicals, effected in the same manner, is to drive off the water of crystallization, whereby the crystals lose their shape, fall into a friable powder and the salt loses considerable weight. Such salts are termed **exsiccated.** (Example: Sodii Carbonas Exsiccatus.)

When Salts lose their water of crystallization by spontaneous evaporation they are said to **Effloresce. Efflorescence** is the opposite of **Deliquescence.**

As in the evaporation of liquids, the vaporization is facilitated by the extent of surface exposed by the substance to the source

of heat and to the medium which serves to carry off the vapor—the air.

The rate of evaporation, therefore, is governed greatly by the following circumstances:

(1) The percentage of moisture in the air, and the rapidity with which the air in contact with the substance is removed.

(2) The state of division of the substance, or physical condition, and its affinity for water.

The degree of temperature at which vegetable drugs are dried, varies with the character of the drug. While the maximum heat considered safe, 60°C. (140°F.), may be applied to most roots, i. e., Taraxacum, Inula, Senega, Gentian, etc., a temperature of 49°C. (120°F.) should not be exceeded for herbs containing delicate principles, such as Belladonna, Hyoscyamus, Digitalis, etc.

Parts of plants containing aromatic or other volatile constituents, such as the different Mints, Wild-cherry bark, and the various gum-resins, Asafœtida, Myrrh, etc., should be dried very carefully, lest their active principles should escape, thus rendering the drug more or less inert. Substances of the class named are frequently dried spontaneously by exposure to a warm atmosphere.

It is quite as important that the temperature at which the drug is dried be not so high as to volatilize any fugitive principle—in other words, that it be **properly** dried—as that the substance shall contain no moisture, that is, be **thoroughly** dried.

PRESERVATION OF DRUGS AND PHARMACEUTICAL OPERATIONS.

The preservation of vegetable drugs is highly important, and deserves more attention than it usually receives. The more fleshy parts of plants, for instance, roots of Rhubarb, Jalap, Colchicum Calumba, etc., as found in pharmacies are frequently worthless. This condition is generally due either to the fact that the root was not properly dried or "cured" when purchased, or that it had commenced to deteriorate when procured from the dealer.

To remedy this condition, the pharmacist should select only whole drugs of choice quality, and if, upon examination, they should prove to be imperfectly dried, steps should be taken at once to effectually free them from moisture by a proper application of heat. This can be readily accomplished by improvising a simple arrangement as outlined before.

Garbling.

Vegetable substances should always be carefully examined for the detection of possible adulterations, either intentional or accidental. This operation is termed garbling, and substances so treated as **garbled.**

The most common form of accidental admixture in parts of plants, such as roots and leaves, is portions of the stems, which, being usually woody and inert, detract from the quality of the drug, and should invariably be rejected.

Cimicifuga, Leptandra, Ipecac and Gelsemium are specimens which in the whole or crude state are frequently mixed with considerable quantities of inert stem. Dirt, especially earth adhering to the fibers, is met with generally in Hydrastis, Leptrandra and Valerian.

Sometimes the admixture is **intentional**, when it is more difficult to detect it, since specimens possessing nearly similar physical properties, and similar also in appearance, are used for adulteration.

More attention should be paid by pharmacists to the **quality** of drugs, since adulteration and even sophistication can be detected in crude substances usually without much labor.

Unfortunately, crude drugs are not procured in a form which admits of ready examination, since they are generally put up for the market in **pressed** packages. Herbs and Leaves, when procured in small packages, should be examined by opening one or more of these in each large package, so that the quality may be noted. Preference should always be given to drugs in bulk, since they admit of ready examination, give better satisfaction and are more economical to use.

Comminution.

Crude organic substances as a rule require reduction to small or fine particles for pharmacal purposes. This process is termed **Comminution** (from con and minuo, Lat., to lessen), and embraces the following operations: Slicing, Cutting, Grating and Rasping, chiefly employed as preparatory to operations more effectual in reducing substances to finer particles.

Contusion is the operation of "bruising" drugs in a fresh or moist, state by pounding or beating them in a mortar.

Grinding and Powdering.

Grinding is the most common operation of the process of comminution. It is effected in mills and produces various degrees of fineness.

The vegetable substances used in medicine may be generalized from the standpoint of comminution—the process of reducing to small particles—into fibrous, cellular, stony, horny (flexible) and fragile or conchoidal.

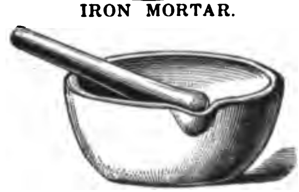
Powdering.

Most substances are more readily acted upon by solvents when reduced to powder, for the reason that in this form the

greatest surface is presented to the solvent action of the liquid.

Vegetable drugs consisting of parts of plants are composed of cellular tissue in which the active principles are found. The medicinal constituents, alkaloids, neutral principles, resins or acids, are in solution in the sap flowing through the cells which make up the tissue, and, upon evaporation of the water in the process of drying, are left in these cells in a more or less

IRON MORTAR.



PORCELAIN MORTAR.

WEDGEWOOD MORTAR.

soluble condition. When, therefore, it is desired to obtain these principles in solution, it is necessary to rupture the cell-walls, so that the solvent action of the liquid used in the extraction (menstruum) may exercise its full power.

It is obvious, therefore, that the **degree** of fineness of a powder of any given drug should be, as far as practicable, proportioned to the size of the cells which make up its structure.

A general rule is: When alcohol, or strongly alcoholic menstrua, are used, the drug to be extracted must be in very fine powder to admit of complete exhaustion.

For this reason, Cinchona, Aconite, Belladonna, Nux Vomica, etc., are directed to be in very fine powder.

The fineness of drugs whose active principles consist of acids, i. e., Senna, Gentian, Taraxacum, or other similar principles soluble in water, need not be greater than that of a moderately coarse powder; the water permeating the cell-walls and inducing the osmotic action, exhaustion will soon be completed.

Gum, pectin and **sugar** are inert substances frequently present in drugs, and since they are rendered more or less soluble by water or watery menstrua, they may retard extraction if the drug be in a very fine powder.

Mortars.

This well-known piece of apparatus, the first invention of aboriginal man for the purpose of reducing vegetable substances to a condition suitable for food, is indispensable in the pharmacy and has long been the accepted symbol of the art and the profession.

Mortars are made of **wood, stone** and **marble** for contusing; of **brass** and **iron** for contusing and powdering, and of **porcelain** and **glass** for triturating.

The **Wedgewood** mortar, so named after the inventor of a kind of earthenware made in England, is the most durable and suitable of any.

In its various shapes and sizes it answers the purposes of all the operations of powdering, trituration and mixing, but not that of contusion, since it is very hard and easily fractured by a hard blow of the pestle.

In the pharmacy some drugs may be powdered in an iron mortar placed upon a stand fixed in the ground, and provided with a spring to the pestle firmly fastened to the rafter of the ceiling. A cord attached to the small end of the spring and fastened to the pestle handle permits the pestle to descend by the force of the hand.

Trituration.

Trituration (from tritus, Lat., to wear) is the operation of reducing a substance to the finest state of division by grinding the particles together for a long time.

While in a pharmacal sense a powder may mean any degree of fineness, in a popular sense a "powder" means the highest attainable degree of fineness. To such is often also applied the term "pulverized" (from pulver, Lat., powder).

The finest state of division of solid substances is designated in pharmacy as **impalpability** and such fineness as **impalpable.** An impalpable powder is defined as a powder of such fineness that **its particles are not sensible to the touch.**

The powdered drugs and chemicals of commerce are usually of this degree of fineness, obtained by trituration.

The reduction of vegetable substances to this degree of fineness is generally conducted on a large scale, since it requires expensive machinery and steam power.

The dusting process is that usually employed, and consists in crushing the drug by means of stones of large diameter and great weight, revolving on a base; the dust which rises during the process accumulates upon the platform placed at a height of about four feet, and is collected. Such mills are termed "chasers."

Drugs which present a **conchoidal** fracture, and are more brittle, are easily powdered on a small scale in a ball-mill, or "pot-mill," which consists of a hollow ball of any desired dimensions, revolving upon an axis. In

the interior of this hollow ball are placed two or more cannon balls (through a convenient opening which may be closed with a large flat cork). The weight and triturating action of the cannon balls reduce the substance quickly to a very fine powder.

Chemical substances are easily triturated in a mortar to a very fine powder. Active medicines, such as Calomel, and Alkaloids and active principles, are triturated with other substances, such as Milk Sugar, to insure more complete division and enhance their medicinal action. (See Triturations, U. S. Ph.)

Levigation is the operation whereby a substance is reduced to the finest particles by triturating it with a **liquid.** It may be performed either in a mortar or on a slab with a muller. The trituration of metallic oxides with liquids, in the preparation of ointments, as in Ung. Hydrargyri Oxidi Rubri, is a good example.

Sifting.

The operation of separating the coarse from the fine particles of a substance, which has been ground or powdered, is termed **sifting.**

It consists of passing the substance through a sieve, made of cloth of different sized meshes corresponding to the various degrees of fineness desired. These cloths are of iron and brass wire for the coarse and fine powders and of hair and silk, or bolting-cloth, for the finest, or impalpable powders.

For the purposes of extraction it is necessary to have the drugs of a uniform fineness, and this is obtained by passing them through sieves of a certain number of meshes to the linear inch.

These degrees of fineness are directed by the U. S. Ph.:

A very fine powder	No. 80 powder
A fine powder	No. 60 powder
A moderately fine powder	No. 50 powder
A moderately coarse powder	No. 40 powder
A coarse powder	No. 20 powder

Elutriation is the operation of separating the finer particles of a substance by suspending the powdered substance in water —decanting the lighter portion freed from the heavier coarse particles and obtaining them in a fine condition by subsidence and evaporation of the water.

This operation has been termed "water-sifting." It depends for its action upon the adhesion of the smaller particles to the water-molecules. Prepared Chalk is a well-known example of a substance "prepared" by this method in the form of "cones" or "drops" free from grit, by allowing the semi-liquid mass to "drop" from a funnel on a metal plate and then to dry by heat. This is sometimes called **Trochization.**

QUESTIONS ON LECTURE II—SERIES 21.

Important.

Students will answer these questions on **letter size** paper (about 8 x 10 inches) **in ink,** writing only on **one** side of the paper, and forward it promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all rules of the "Important Notice" must be complied with.

THE DIRECTOR.

1. What is meant by Heat?
2. How may Electricity be converted into heat?
3. Account for the fact that Heat produces **expansion.**
4. In what three **forms** does Matter exist?
5. How is Heat measured?
6. Name the different thermometric Scales and the Boiling and Freezing point in each.
7. Convert 50 C. into Fahrenheit degrees. Convert—30° F. into Centigrade degrees.
8. How is Heat transferred: In Solids; in Liquids; in Gases?
9. Describe the Bunsen burner.
10. What is Latent heat? Sensible heat?
11. What are the principal **sources** of Heat in pharmacal operations?
12. If a Liquid, through application of heat, changes its **form,** what is the process called?
13. What considerations should be observed in **conducting** the process of Evaporation?
14. How may the Boiling Point of a liquid be **determined?** Is it the same for **all** liquids?
15. What two processes constitute Distillation?
16. In what respect does Sublimation differ?
17. What is a Retort? Why is it usually made of Glass?
18. How is a Condenser constructed? What is essential for its operation?
19. What is meant by Fractional Distillation? Destructive Distillation?

20. Name an official article obtained by Destructive Distillation.

21. What is the object of Sublimation?

22. Why is the Melting Points of Solids of **particular** importance?

23. Distinguish between Deliquescent and Hygroscopic.

24. What is Torrefaction? Give an example.

25. Can all Solids be changed to Liquid State without chemical change? If not what are they called?

26. Name four Operations to which an organic Drug could be **successively** subjected by the application of Heat?

27. What is Desiccation? Exsiccation?

28. What is Calcination? Its object?

29. What is the object in reducing Drugs to powder for extractive purposes?

30. Give a general rule for determining the proper **degree** of fineness of a powder for Extraction.

31. What is Trituration?

32. What is meant by an Impalpable powder?

33. Describe and distinguish between two operations whereby solids are obtained in **finely divided** form through the use of Liquids as Media?

34. What is meant by a **water-bath?** Of what use are Baths in pharmacal operations?

35. Name the Baths or Media employed for obtaining the following temperatures: A gentle heat; a moderate heat (below boiling); between 100° C. and 108° C.; 150° and 300° C.; above 300° C.

36. What is the Product of Distillation called; of Sublimation?

37. Name an official article that is a product of Sublimation.

PHARMACEUTICAL OPERATIONS.

Solution.

When a solid is transformed into the liquid state, by heat, it may be said to undergo the process of liquefaction, but when a substance (solid or liquid) is rendered into permanent liquid form by distributing its particles throughout the liquid it is said to **pass into solution.**

Solution as a pharmacal operation, therefore, is the mechanical **separation** and **diffusion** of the molecules of a substance through a **liquid.**

For example, when a small quantity of common salt is placed in water, it gradually disappears from view, the water becomes saline to the taste, and its specific gravity is increased. This liquid mixture of salt and water is called a **solution.** The liquid in which the solution takes place is called a **solvent.**

In all cases of solution proper, neither the solvent nor the dissolved solid undergoes chemical change. The solid retains all its original properties except solidity, and may, by evaporation of the solvent, be recovered from the liquid in the original form, without loss of weight. Such solutions are called, for convenience, **simple** solutions.

Solution is often accompanied by chemical combination, that is, the solid not only disappears in the liquid, but at the same time undergoes chemical change, or enters into combination with the liquid.

The resulting liquid is, for convenience, called a **chemical** solution, or a **complex** solution. The particles are pulled asunder and diffused through the liquid by virtue of the attraction exerted upon them by the molecules of the liquid. In chemical combination, on the other hand, a new force comes into play, that of chemical affinity, which changes the identity of the substances and builds up new compounds out of the old.

For example, if a small quantity of Iodine be added to an aqueous solution of Potassium Hydroxide (caustic potash) and the mixture be heated the Iodine will gradually disappear, but it will be found, on examination, that something more than solution has taken place. On evaporating the liquid, no Iodine, as such, will be found, the Potassium Hydroxide will have disappeared and entirely new compounds will be found in the residue.

Another difference between these important processes is their effect on temperature.

A lowering of the temperature always results from solution,

while chemical combination invariably produces the opposite effect.

In the case of many anhydrous substances, as Lime and Caustic Alkalies and Alcohol and Sulphuric Acid, their solution in water produces an elevation of the temperature. This apparent exception to the law is due to the fact that they combine chemically with a portion of the water and such solutions should, therefore, be strictly regarded as chemical solutions.

In the case of a mixture where both solution and chemical combination take place, it is evident that the opposite effects of these two processes on the temperature will tend to neutralize each other.

The solution of many salts causes so great a reduction of temperature that advantage is taken of it to produce **freezing mixtures**, as when Common Salt is mixed with Snow a temperature more than forty degrees below the freezing point is attained.

Another difference between solution and chemical combination is the fact that the latter takes place most easily between substances which are most unlike, while solution usually takes place most readily between substances that most resemble each other in composition and properties.

Thus Acids and Alkalies form chemical combination and solution, while Fats form simple solution with Ether and Resins with Alcohol.

As solution is one of the most important agencies in the hands of the pharmacist for performing many operations, it is important for him to understand the conditions most favorable to the operation.

As a great general rule, whatever weakens the cohesion of the particles of a substance promotes solution.

The means used to weaken cohesion are chiefly three in number:

(1) Heat, (2) Mechanical division, and (3) Favorable position of the substance as regards the solvent.

Heat weakens cohesion, because it increases the spaces between the molecules, and also because it increases molecular motion.

A hot solvent is usually more speedy in its action, and takes up a larger quantity of the solid substance than a cold one. But the law has some notable exceptions. Common salt, for example, is no more soluble in hot than in cold water, and Lime is far less soluble in the former than in the latter.

The mechanical division of a substance is accomplished in various ways: by agitation, by grinding, as in a drug-mill, and

by trituration, as in a mortar. It not only weakens cohesion, but by reducing the substance to a fine powder exposes a vastly greater surface to the action of the solvent.

When weak solutions of readily soluble substances are to be made, the method of agitation is usually to be preferred; that is, the substance is dropped into a suitable vessel, and the mixture shaken until solution is complete. Where strong solutions are required, or where the substance is not readily soluble, solution is facilitated by trituration with a solvent in a porcelain mortar. The substance is first rubbed to a powder, a little of the solvent is then added, and the rubbing continued until the liquid is saturated or nearly so, when this portion is poured off in the same way. This process is continued until all of the substance has been dissolved.

The importance of a favorable position of the substance with reference to the solvent, is shown in the method of **circulatory displacement.**

The substance to be dissolved is suspended just beneath the surface of the liquid, on a porous diaphragm, or in a bag of some porous material. The liquid in contact with the substance dissolves a portion of it, has its specific gravity increased in consequence, and therefore sinks to the bottom of the vessel, and a fresh portion of the solvent is brought in contact with the substance. Currents are thus established in the liquid, the effect of which is to keep that portion of it, which is farthest from saturation, and has most solvent power, in contact with the substance to be dissolved.

Many substances are so readily soluble that either heat or division effect their solution so rapidly as to retard the process. This is for the reason that the liquid becomes quickly saturated and of such thick consistence (viscid) as to envelope the solid particles and prevent access of fresh solvent. Sugar dissolves more rapidly in coarse powder (granulated) than in fine powder and Gum Arabic forms a solution with cold water more quickly than when heated.

Solubility.

Different solids differ from each other very widely in solubility. A few are insoluble, many slightly soluble, and many freely soluble.

Some, like Gum Acacia, are soluble in all proportions, and some, like Potassium Chlorate and Calcium Sulphate, only in limited proportions. Some that are insoluble or nearly so in pure water, become freely soluble in certain saline solutions, as for instance, Benzoic and Salicylic Acids, that dissolve but sparingly in pure water, are dissolved in large quantities by solutions of Alkaline Acetates, Carbonates and Phosphates in

water, but this cannot be regarded as strictly simple solution. The reverse is usually the case, however, as, for instance, an aqueous solution of Sugar will dissolve less of a salt than pure water.

Substances that are sparingly soluble in one liquid may be freely soluble in another, as Camphor, which is taken up only in small proportions by Water, but is dissolved in very large quantity of Alcohol and Sulphur, which resists the action of all ordinary solvents, but melts away like sugar in water, when agitated with Carbon Disulphide.

The quantity of a solid which a solvent will take up must be determined by experiment in each case, as there is no known law governing **solvent action.**

The solubility of most substances varies regularly with the temperature until a certain limit is reached, beyond which no further increase takes place; but in some cases solubility increases faster than the temperature, and in others it increases to a certain point with heat, and then declines. As in the case of liquids, the Specific Gravity and Boiling Point and in some solids the Melting Point, are regarded as important characteristics, and reference is made thereto in the U. S. Ph., so is the solubility of a solid indicated by the **number of parts of the different liquids** required to effect complete solution of **one part of the solid.**

Since the solubility is influenced by temperature, solubilities are referred to some uniform temperatures, such as 25°C. (77°F.).

The most common Solvents are: Distilled Water, Alcohol, Ether, Chloroform, Benzin, Carbon Disulphide and the Fixed and Volatile Oils of which latter Oil of Turpentine is the type.

A solvent is said to be saturated when it refuses to take up more of a given solid. The term is also used in a chemical sense. For instance, an acid is said to be saturated with an alkali when the solution is neutral to test paper.

Refer to Solubilities of the principal chemicals in the U. S. P., a solvent is said to be **supersaturated** when it contains in solution more of a solid than it would take up if the solid were treated with the solvent at the given temperature.

For example, if we prepare a saturated solution of Sodium Sulphate in a test-tube, and stop the test-tube while the liquid is still boiling and allow the solution to cool, without agitation, to the temperature of the air, it may be kept for weeks or months without crystallizing; but if a glass rod

be plunged into it, crystals will suddenly be formed through the entire mass.

The phenomenon is accounted for by supposing that the molecules, being held in equilibrium by their mutual attractions, are not free to obey the polar forces that produce crystallization until a disturbing cause is introduced.

The term supersaturated is also used in an entirely different sense by chemists. An acid, for instance, is said to be supersaturated by an alakli when more than enough of the latter has been added than is sufficient to neutralize the former.

Diffusion of one liquid through another is of the same nature as solution, and, like it, is a phenomenon of **molecular attraction.**

Liquids differ from each other very widely in their power to diffuse through water. Some, as the Fixed Oils, do not mingle with Water at all; others, like the Volatile Oils, are sparingly dissolved by it, and still others, as Glycerin and Alcohol, mingle with it in any proportion.

Theoretically there is no difference between the diffusion or the mixing of one liquid with some other liquid and solution and this property is therefore usually referred to as **solubility,** e. g., that volatile oils are soluble in Alcohol, or sparingly soluble in Water, etc.

Osmosis.

The mingling of liquids or gases by diffusion through animal or vegetable tissue capable of being wet by both liquids, is called **osmosis.**

Such membranes possess multitudes of excessively minute pores which constitute so many capillary tubes, by means of which the liquids are brought in contact with each other and enabled to commingle. This phenomenon is due to **capillarity,** a result of molecular attraction.

When the process of osmosis is applied to the separation of the crystallizable from uncrystallizable substances, it is termed **Dialysis.**

The strength of the currents passing in opposite directions through the membrane depends partly on the densities of the liquids and partly on their power to wet the membrane. Other things being equal, the strongest current is toward the denser liquid; and if the liquids are of equal density the stronger current will be toward the liquid that has the least power to wet the membrane.

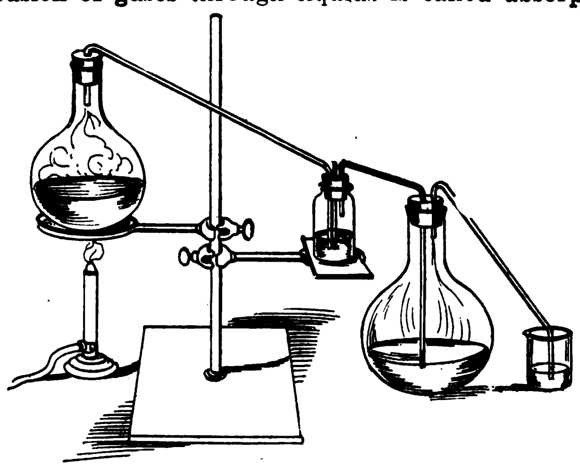
Crystalloids diffuse readily through porous membranes, colloids do not; hence it becomes possible by osmosis to separate the latter from the former, by **dialysis.**

A Dialyzer consists of two vessels, one suspended in the other. The outer vessel contains the liquid in which it is desired

to obtain the diffusible portions, distilled water being mostly used for this purpose. The inner vessel, or the dialyzer proper, consists of a ring of India-rubber or glass, to which a piece of parchment paper is securely fastened, as in a drum, at the bottom. The liquid to be dialyzed is poured into the last mentioned vessel, which is then suspended in the water so that the bottom barely reaches below the surface of the water. In pharmacy this process is used in the preparation of Dialyzed Iron and some Alkaloids. The mixing, or simple diffusion of liquids, when unaccompanied by chemical change, usually causes no change of temperature.

DIALYZER.

The diffusion of gases through liquids is called **absorption.**



ABSORPTION OF GAS.

This is also a phenomenon of molecular attraction, and does not differ in its essential nature from solution. Its effects on temperature, however, are often different from those of solution. In cases where large quantities of a gas are absorbed by the liquid, the temperature rises, because the absorbed gas is condensed in volume, and a portion of its latent heat is thereby rendered sensible. Also an elevation of temperature usually facilitates solution, while a lowering of temperature

increases the absorption of a gas. Pressure has the same effect. This is illustrated in charging a Soda Fountain with Carbon Dioxide.

Filtration.

Filtration is the process of removing undissolved matter from a liquid; the clear liquid thus obtained is termed the **filtrate.**

When the operation is applied to viscid substances, such as syrups, oils, etc., or to remove grosser impurities, it is termed **straining.**

Filtration, in pharmacy, is usually applied to solutions in which the substance dissolved has been thrown out of solution precipitated, from a change in temperature or other cause. The operation is always effected mechanically by passing the liquid containing the undissolved matter through some material of sufficiently close texture to arrest the solid particles, while the clear liquid is allowed to flow through freely. Such material is termed a **filtering medium** (plural, **media**).

The most common Filtering Media are: Paper, Cotton, Sand, Glass-wool and porous Earthenware, the form of the auxiliary apparatus employed, except in the case of the last mentioned, being a **funnel.**

The nature of the filtering medium used depends upon the **mobility** of the liquid and the character of the undissolved matter. With watery, alcoholic, etheral and similarly mobile liquids, when not too concentrated, filter paper is commonly used.

Filter-paper is of two kinds, **gray** and **white,** the former being the kind chiefly used in pharmacy; the white is employed in chemical operations.

The **rapidity** of filtration is of great importance, both for expediting work and to prevent loss by evaporation, not always avoided, even though the vessel used in the operation be well covered.

Filtration is favored, other things being equal, by the following considerations:

(1) The filter should be carefully folded. The folding of a filter, or "pleating," is accomplished in various ways, but no filter can be considered perfect unless folded to resemble a fan with 32 exactly equal parts, with the edges perfectly even when laid together (as in a fan) and narrowing down to as small a point as possible, without breaking the paper. The

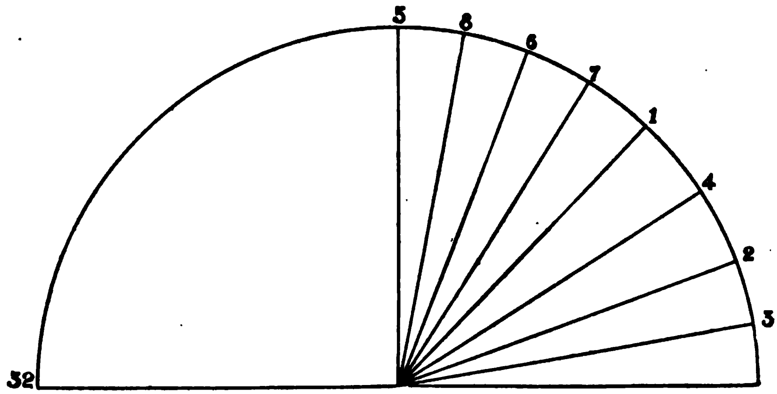
result is easily accomplished in a very simple manner, as follows:

The sheet of round filter-paper is to be folded into 32 equal parts, the folds passing through the center. The sheet is first folded into halves by laying its circular edges evenly together and making a sharp crease along the fold with the thumb-nail or a spatula, then into quarters by folding at 5.

For better illustration (see figure), we shall now number the different parts of the double sheet according to the 16 parts the half circle represents, each successive **fold** being designated by its respective number.

The first fold is made at 1; it is then opened out and folded **forward** at 2; then **backward** at 3, and again **backward** at 4.

Each fold should be made perfectly straight and as close to the point as practicable without rupturing the paper.



FOLDING OF FILTER-PAPER.

The folded parts 1, 2, 3 and 4 are then gathered up to 5 and folded at 6, then folded **backward** at 7, then **forward** at 5 and **backward** again at 8, which completes the folding of the 16 parts or one-half of the circle or filter.

The other half is folded in precisely the same way.

(2) The filter should be pushed down into the neck of the funnel as far as possible without rupturing the paper.

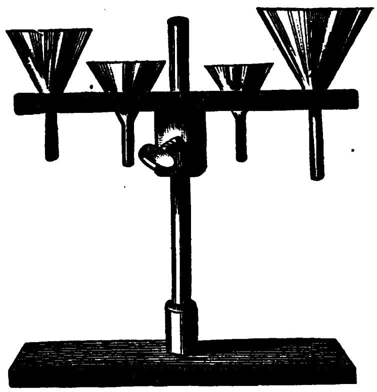
This is especially desirable when syrupy liquids are to be filtered, such as elixirs and similar liquids which filter slowly. For this purpose a funnel with a wide neck should be employed (see Funnels); the point of the filter paper is by this means strengthened, and the crevices formed in the paper, when pushed down into the comparatively narrow neck of the funnel, facilitates filtration, and aids in rendering the filtrate clear.

Filtration is usually further facilitated, in this and other kinds of filters, by allowing the liquid to flow through a tube, which is connected air-tight with the filter, from a height of 10 to 30 feet; this is termed filtration by **pressure.**

(3) The filter should be thoroughly moistened with water and allowed to drain before the liquid to be filtered is poured

in. This is necessary, only with watery liquids and especially with strong solutions.

The pleated filter is opened out completely and then pushed down into the neck of the funnel by gently pressing the top with the flat hand; while held there firmly to prevent its slipping up, a small stream of water is sent into the funnel by means of a wash-bottle or "spritz." When the paper has become in the least moist, it will adhere to the glass without danger of slipping, and the hand must be removed, since the least pressure will rupture the paper. The funnel is now gently turned by the hand so that the



ANALYTICAL FUNNELS.

thin stream of water may be evenly distributed, then set aside for a few minutes to allow the superfluous water to drain off, when it is ready for use.

During the operation, the following points should be observed:

(1) Provision must be made for the air to escape from the receiver.

(2) The filter should be kept filled with the liquid, and

(3) The funnel should be kept covered.

The air is usually allowed to escape by placing a loop of twine in the neck of the receiving bottle, or by supporting the funnel in a ring so that it may not fit tightly in the bottle.

The more liquid in the filter, the greater the pressure, and therefore the more rapid the filtration; hardening of the undissolved matter, and consequent stopping up of the pores of the paper, may be prevented by having the filter as full of the liquid as possible.

The funnel should always be kept well covered, to prevent evaporation; this is best effected by the use of pieces of rubber packing, which fit closely on the edge of the funnel; pieces of glass or cardboard may also be used.

The filter-paper must never extend above the top of the funnel.

The pleated filter, previous to being moistened, should be inserted in the funnel and measured as to length; if it extends beyond the rim, it should be cut off evenly, so as to reach rather half an inch below than above

the top. This is done partly to facilitate covering the funnel, which cannot otherwise be effectually done, but more especially to prevent evaporation, which sometimes takes place so rapidly, when the filter extends considerably beyond the funnel, as to carry some of the liquid down the outside. An illustration of this phenomenon, due to **capillarity,** the is shown in accompanying figure

CAPILLARY ATTRACTION.

White filter-paper is best adapted for the analytical laboratory and for filtering acid and alkaline solutions where the gray would be objectionable, because of its colors and impurities being soluble in chemical reagents. Its principal use in pharmacy is in filtering solutions containing precipitates, which latter it is desired to obtain pure by washing with water. For this purpose a funnel resembling an equilateral triangle is most convenient, since the precipitate is more exposed upon the sides than in the ordinary funnel for pharmacal use. This filter-paper is also folded in quarters, and simply dropped into the funnel to adjust itself by the weight of the contents, so that all portions of the precipitate may be washed by the water poured upon it.

Various devices are in use for facilitating filtration, such as **filter-racks,** made of wire, also **supports,** consisting of a china cone with openings in the sides, to be placed inside the funnel, etc. These do not insure such rapid filtration as by the simple funnel with attention to the above rules.

Continuous filtration is employed when larger quantities are to be filtered, and when the filter is of limited capacity.

CONTINUOUS FILTRATION.

It may be effected by inverting the bottle containing the liquid over the funnel through an opening in the cover, which admits the neck below the top of the filter, as shown in the illustration. By this arrangement the filter is kept filled with liquid up to the level of the neck of the inverted bottle as long as any liquid remains in the receiver, the liquid acting as a valve, by excluding the air from the latter. As soon as the liquid in the filter sinks below the neck of the container, air rushes in and displaces it until the level is again reached, thus working automatically. The splashing by the outrushing air may in a great measure be prevented by inserting a perforated cork in the neck of the container, so that the displacement will take place more gradually.

Filtration in vacuo is accomplished by exhausting the air from the receiving vessel with an air-pump. It is chiefly employed in the chemical laboratory in filtering

viscid alkaline solutions, or such liquids as act upon the filter-paper, causing it to retard their flow. A small perforated cap of platinum is placed in the neck of the funnel to prevent the point of the filter from breaking by the suction created. The **mercury pump** is the means employed in small operations for producing a vacuum; in the arts pumps worked by steam power are used.

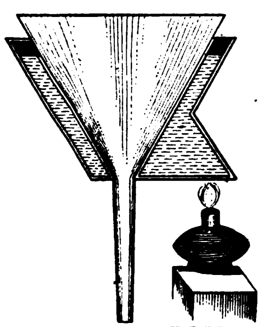
The filtration of oils is effected either in the cold, or through heated filters.

In the cold, oils require to be filtered through substances more porous than paper, i. e., cotton, flannel, etc., and usually upward, so to prevent the impurities clogging the medium.

Hot or water-bath filters are constructed in different ways, the most common form being an ordinary funnel placed in a double or jacketed cone of tinned iron filled with water, and furnished with a projecting tube which is heated by a flame.

Filtering media, other than those mentioned, are:

Absorbent Cotton, for neutral mobile liquids. This is especially useful for filtering small quantities of liquids. A small pledget is pressed into the neck of the funnel and held in place with a glass-rod while it is covered with water and then thoroughly drained.



HOT WATER FILTER.

Sand is sometimes a very useful filtering medium, and is especially adapted in connection with alternate layers of charcoal for filtering large quantities of water. **Pumice-stone** powder is frequently mixed with gummy or resinous substances to facilitate the passage of liquid solvents.

Sponge is used for straining, but does not present any advantage, since it is difficult to clean perfectly and too costly to reject when once used.

Chamois skin is sometimes used as a filter-cloth when pressure is applied. Owing to its great strength it is not liable to rupture.

Earthen-ware, such as the so-called Pasteur filters and **Porous Sand-stone,** are very effective in filtering Water and freeing it from Bacteria. Such media should be cleaned frequently, scrubbed with diluted acid, or exposed to a red heat to remove the matter lodged in the pores and to restore capillarity.

Straining.

Straining differs from filtration mainly in that it is applied to the separation of coarse particles from liquids, and that therefore more porous media are used than in Filtration.

This operation is usually applied to the more viscid liquids or mixtures to free them from gross impurities, as, for example,

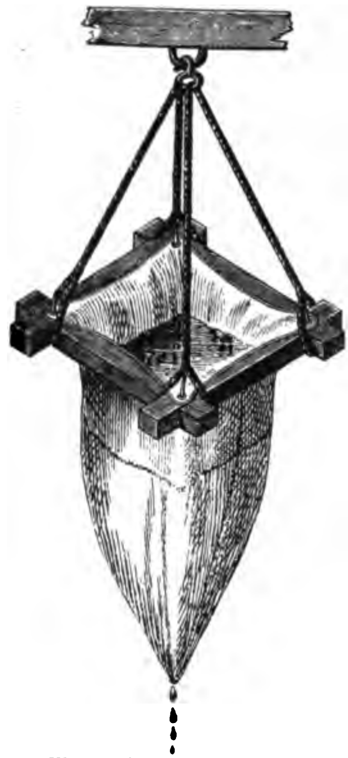
in the making of syrups, also to Infusions, Decoctions and to Precipitates, which differs in that the solid is retained, the liquid being rejected.

The materials most frequently used for straining are: Cotton, Cotton-flannel, Felt-bags, Unbleached Muslin and Calico.

For small quantities, a plug of cotton, placed tightly in the neck of a funnel, is the most convenient.

For large operations, as in making syrups, a felt bag is the most convenient and satisfactory means, since the whole amount of liquid may be poured in at once and returned to the bag until it runs clear.

The **tenacle**, consisting of four pieces of wood joined together so as to form a square, and furnished in each corner with a projection upon which the filter is fastened, is a convenient device for suspending the bag or filter cloths above the receiving vessel. It may be supported by a stand, or suspended from the ceiling by a hook.



FELT-BAG STRAINER WITH TENACLE.

In straining syrups, it is even more important that the strainer be thoroughly moistened with **water** than in filtration through paper.

When a felt bag is used it should be soaked in water until completely saturated, then wrung out or pressed as hard as possible to free it from superfluous water. When the liquid to be strained is poured in, it **displaces** the water, which first comes through almost pure, and should be returned to the filter. Since a considerable portion of the liquid remains in the pores of the filter at the close of the process, it should be also displaced by the addition of sufficient liquid to make up the measure.

Clarification.

When a liquid contains insoluble matter suspended in so finely divided a form that it cannot be separated by simple filtration, some other insoluble substance is added to which the insoluble matter is attracted, or the chemical character of the liquid is changed so that it may be obtained **clear—clarified.**

Clarification may be either pharmacal or chemical.

When clarification is effected by pharmacal means, or filtration, the insoluble substances used form a layer over the filter, which retards the insoluble matter but does not impede the flow of the liquid.

The substances used for Clarification in order of their merits, are:

(1) **Paper pulp,** prepared by beating in a bright iron-mortar a sheet of gray filter-paper, moistened with sufficient water to make a pasty mass.

After pressing out the water, the pulp is added to the liquid and thoroughly mixed by agitation. In commencing filtration the first portions of the filtrate must be returned to the filter until the pulp has formed a layer over the sides, after which the product is obtained clear. Paper pulp is especially useful in filtering elixirs and straining syrups.

(2) **Insoluble chemical substances,** such as Talc, Calcium Phosphate, Pumice-powder; also Magnesium Carbonate.

Since substances used for clarification must be insoluble in the liquid, that they may not contaminate the filtrate. Magnesium Carbonate is objectionable owing to its slight solubility in water, especially if the latter be acid. For this reason it has been superseded in the U. S. Ph. by Purified Talc, which is nearly insoluble in neutral liquids.

The Chemical methods of clarification are:

(1) The use of Albumen in the form of egg-white which effects clarification by chemical means through combining with the soluble matter and forming insoluble compounds, which are usually thrown to the bottom of the liquid—**precipitated.**

By the application of heat albumen coagulates, envelops the insoluble particles and makes the liquid clear, as in the clarification of "coffee" by the addition of egg-white.

Gelatin forms a very insoluble compound with tannic acid, as, for example, in the preparation of leather; and as the insoluble substances which we desire to reject by clarification are mostly tannic acid derivatives, its value for this purpose is clearly recognized and it is extensively employed in the form of Isinglass for the clarification of Beer.

(2) Another method employed for clarification is **Fermentation.**

Some liquids, as the expressed juices of Fruits, often contain insoluble matter in so finely suspended condition as to make its removal by mechanical means impossible. By permitting such liquids to undergo fermentation, the sugar, through which the particles are kept in suspension, is converted into alcohol, in which the suspended matter is also insoluble and therefore is precipitated and easily removed. The clarification of apple-juice and grape-juice in the making of Cider and Wine respectively, are good examples.

Decoloration.

When it is desired to free a liquid from color, it is effected by filtration through some absorbent substance, such as charcoal. The operation is called **Decoloration,** or "Decolorization."

It is purely a **physical** process designed to remove the coloring principle through the capillary attraction of the agent employed.

Animal Charcoal, the agent usually selected, is a mass of minute pores to which many substances in solution are attracted and by them retained.

The liquid is permitted to flow through a layer of the Charcoal in coarse powder, or granulated, placed upon some porous media in a funnel. Alternate layers of Sand and Charcoal are very effective in decolorizing and purifying water, and also to free it from organic impurities, which the charcoal absorbs.

Distinction must be made between decoloration as a form of Filtration and the term frequently but erroneously employed to designate a substance deprived of color by chemical reaction.

Funnels.

Funnels used in filtration should be of glass, in order that the operation may be watched; also because they are easily cleaned, and are not acted upon by chemicals.

WASH-BOTTLE.

The **shape** of a funnel for filtering purposes should be that of a V rather than one so wide at the top as the glass funnels generally found in the shops; one having an angle of 45 degrees will filter more rapidly than one of 90 degrees.

The **wash-bottle,** or "spritz" is a very useful adjunct in pharmaceutical work for washing precipitates, wetting filters, and for introducing small quantities of water in test-tubes, etc. It consists of a rather wide-mouthed bottle or flask furnished with a perforated cork, into which two bent glass tubes are introduced, one reaching down into the liquid and a shorter one ending just above the surface. By blowing in the short tube, the air, pressing upon the surface of the liquid, causes it to rise in the long tube, and to flow out at the contracted end in a fine stream with considerable force.

Crystallization.

Many substances, under certain conditions, particularly when passing from a fluid to a solid state, arrange themselves in regu-

lar geometric forms. Such forms are called **Crystals** (from Krystaino, Gr., freeze, congeal) and the process is termed **crystallization.**

Substances which crystallize are termed **crystallizable,** while those that do not, as shellac, glue and glass, are called **amorphous.** In assuming the crystalline form bodies tend to reject foreign matter, and crystallization is therefore an important process in the **purification** of many substances.

When the regular external form of crystals is wanting, but present in the interior, the body is said to have a **crystalline structure.** Small irregular forms are called **crystalline powder.**

The science descriptive of crystals, called **crystallography,** treats of the various forms of crystals. It needs but a brief reference here.

The form of a crystal depends upon its planes or faces. The point of union of two faces is called an edge; of more than two faces, an angle. The forms of crystals are determined by imaginary lines drawn vertically to the faces or from opposite angles, to intersect each other in a common central point and form angles corresponding to the boundary angles. These lines indicate the directions in which the molecules arrange themselves, according, as it is supposed, to the **polar force** and they are termed the **axes** of the crystal.

According to the number of these axes, their relative lengths and the angles at which the lines intersect in the crystal, there are six different **systems of crystallization** as follows:

1. **Isometric** or Regular, having three axes of equal length intersecting at right angles.
2. **Tetragonal,** Rhombic, or Quadratic, having two axes of equal and one of unequal length intersecting at right angles.
3. **Ortho-Rombic,** or Trimetric, having three axes of unequal length, intersecting at right angles.
4. **Monoclinic,** or oblique Prismatic, having three axes of unequal lengths, two obliquely inclined to each other, intersected at right angles by a third.
5. **Triclinic,** or Doubly oblique, having three axes of unequal length, all obliquely inclined to each other.
6. **Hexagonal,** or Rombohedric, having one axis of unequal length intersecting three of unequal length at right angles.

The following terms are commonly employed to designate shapes of crystals:

Prismatic, shaped like a prism.

Tabular, with a flat (table) top.

Laminar, in thin plates or scales (flakes).

Acicular, needle-shaped.

When a substance crystallizes according to more than one system it is said to be **di-, tri-,** or **poly-morphous** as it assumes two, three, or several forms respectively.

Isomorphous is the term given to such substances as crystallize in the same form.

Many substances, in the process of crystallization, combine with a certain amount of water, which is called **water of crystallization.** This water is usually present in definite proportions and is so given in the Molecular Formula of chemicals, as, for example, $FeSO_4+7H_2O$, means that Ferrous Sulphate of the U. S. Ph. contains 7 molecules of water of crystallization.

When such substances are deprived of their water of crystallization they are said to be **exsiccated,** or dried (Ferri Sulphas Exsiccatus).

When the water is simply enclosed mechanically in the crystals, as in Potassium Nitrate, it is called **interstitial water.**

Crystals may be formed in a variety of ways:

(1) **By sublimation.**—Such substances as Iodine, Camphor, Sulphur, Calomel, Corrosive Sublimate, Ammonium Chloride and Carbonate may by this means be freed from foreign materials.

(2) **By fusion.**—Many substances, as Sulphur, the metals Bismuth and Antimony, and some salts, assume the crystalline form on cooling from fusion. This method has few important applications in pharmacy. Of much greater importance is the next method.

(3) **By cooling** from solution, or by **evaporation** of the solvent. In the former case a saturated solution of the substance is made in an evaporating dish or other shallow vessel, at an elevated temperature, and the solution is allowed to stand until cold. After the crystals have been deposited the mother liquid is drained off.

Usually not all of the substance crystallizes out at the first trial; the mother liquid should therefore be concentrated by heat and again allowed to cool, and the process repeated so long as crystals continue to form.

In case large and well-formed crystals are desired, the solution should not be too strongly concentrated at first, and the crystals should be permitted to form slowly, and if the nature of the liquid will admit, by **spontaneous** evaporation of the solvent.

In case crystals are required in the form of fine **granules,** the solution should be concentrated until crystals begin to form around the edges of the dish, and then the solution should be cooled rapidly and stirred during the cooling. In many cases the application of heat may be continued until the solvent is evaporated, keeping up in the meantime the stirring. This method is called **granulation.**

Where the solvent is a highly volatile substance like ether, benzol or carbon disulphide, a cold saturated solution is made, and the solvent allowed to evaporate spontaneously. By dissolving Sulphur in carbon disulphide fine crystals of the former substance may be obtained by this method.

(4) **By addition of a substance** to a solution of a crystallizable body, whereby the solvent power of the liquid is diminished and the dissolved matter is thrown out in form of crystals.

This may be effected in two different ways: The addition of a soluble solid having affinity for the liquid, which, passing into solution, produces a supersaturated solution, thus throwing the original dissolved matter out of solution which serves as a **nucleus** for the formation of crystals. For example, Glucose, in watery solution, does not crystallize, but upon the addition of a crystal of anhydrous Glucose it at once forms a crystalline mass, if the solution be concentrated.

It may also be effected by a change in the character of the solvent, as by the addition of Alcoholic liquids, Tinctures, etc., to saturated solutions of Sugar, in the precipitation of Salts in aqueous solution by the addition of Alcohol, etc.

(5) **By Chemical Reaction** in a solution by which an **insoluble** or less soluble substance is formed, which appears as a crystalline **precipitate.**

Precipitation.

Precipitation as a chemical process is the operation whereby an **insoluble** compound is formed from mixing the solutions of two or more **soluble** compounds. The product is termed a **precipitate.**

In a chemical sense, precipitation is always the result of a **chemical decomposition,** new compounds being formed. Since the result depends upon the insolubility of the newly-formed compounds, this process can only be employed where the product is known to be insoluble.

For example, when two soluble salts, Potassium Iodide and Lead Acetate, are dissolved separately, and their solutions mixed, a chemical change takes place, due to an interchange of the elementary constituents of the substances, and new compounds are formed—Lead Iodide, which, being insoluble in water, is precipitated, and Potassium Acetate, which is soluble and remains in solution in the water.

The term precipitation is also applied to any substance which is thrown out of a solution from a liquid, as, for example, precipitates in Tinctures.

The compound in solution is separated either by **decantation,** when heavy or crystalline, or by **filtration,** when flocculent or gelatinous.

Decantation.

When a precipitate is desired in a pure form it is necessary **to wash** and **dry** it. The precipitated matter is washed by trans-

ferring it to a filter, and after having been drained, small portions of liquid, usually distilled water, is poured upon it. After having again been drained it is dried, either in a drying-oven or by simple exposure to the air.

DECANTATION WITH GUIDING-ROD.

Decantation is the simplest method for the separation of Liquids. It is effected by pouring the liquid into a tall and narrow vessel and after subsidence of the heavier, or insoluble portion, the clear liquor is poured off.

In pouring from such vessels, especially when not furnished with a lip, it is necessary to use a guiding rod, as shown in the illustration to prevent the liquid from running down the outside.

Other methods of separating liquids are by means of the **Syphon,** which depends for its action upon the quantity of the liquid in the longer and lower end of the tube, and the **Pipette** and **Burette,** glass-tubes with bulbs, which are also used for the accurate measurement of liquids.

Extraction.

Extraction is the process by which the soluble matter of organic drugs is obtained or separated from the insoluble portion. When extraction is completely effected the drug is said to be **exhausted.**

Extraction may be effected by either of the following operations:

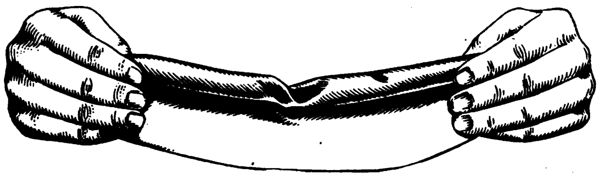
(1) Maceration, Expression and Filtration.
(2) Maceration with heat, Expression and Straining.
(3) Maceration and Percolation.

Maceration consists in mixing the drug, reduced to a coarse powder, with the liquid used for extraction (the menstruum), and allowing the mixture to stand for some time (from 1 to 36

hours, according to the proportion of the menstruum used and the nature of the drug).

When the soluble matter of the drug has become dissolved in the menstruum, it is obtained as a clear liquid free from the insoluble portion, the **marc,** by expression.

Expression is the operation of straining through a suitable cloth with pressure exerted either by hand or by a **screw-press.**



STRAINING WITH EXPRESSION.

The most effective way of expressing by hand is to fold together the edges of the press-cloth so that one overlaps the other (as in wrapping a paper package) the ends being meanwhile gathered up so as to prevent the mixture running out. These ends are then twisted in opposite directions, care being taken that the middle fold does not give way.

The custom of adding a portion of menstruum to the marc (drug) after expressing it, is not to be recommended, unless necessary to make up the measure of the product. It is preferable to use as much more menstruum originally as will be retained by the marc, which can easily be approximated by experience and observation.

In extracting a drug by simple maceration the temperature should be moderately warm, as the solvent action on the drug is then greater.

In extraction by any form of maceration, with or without heat, the drug should be in a coarse powder.

When in fine powder the small particles of drug rapidly swell and adhere to each other as soon as they come in contact with the liquid, and thus prevent the solvent action of the menstruum. The expression of the liquid is also more difficult when fine powder has been used, since the fine portions clog the pores of the press-cloth.

When a drug is macerated in hot water for a short time, by pouring boiling water upon it in a well-covered vessel, the liquid

obtained by expression, upon the cooling of the mixture, is termed an **Infusion.** The U. S. Ph. gives a general process for the Infusions.

Drugs containing volatile princples, i. e., Chamomile, Valerian, etc., are frequently prescribed in this form. The boiling water extracts these principles, and if a proper vessel be used, such as the "Infusion Mug," which can be tightly covered, the water will gradually condense, retaining the fugitive constituents. Infusion from drugs whose active principles are volatilized by heat, are prepared by simple maceration in the cold.

SCREW-PRESS.

INFUSION MUG.

Digestion is maceration in conjunction with heat. When a moderate heat is applied to facilitate extraction in connection with maceration the process is termed digestion. It consists in boiling the Drug in coarse powder, mixed with Water in a covered vessel for 10 minutes, allowing the mixture to cool to 40°C, straining and expressing and adding hot water through the strainer to the required measure.

When the mixture is boiled for some time the liquid product obtained by expression is termed a **Decoction.** For these a general process is given in the U. S. Ph.

Percolation.

As extraction is the most common of pharmacal processes so is percolation the most important, related operation, since it is the most effective, economical and expeditious method for the extraction of the medicinal principles of drugs.

The process of Percolation, as directed in the U. S. Ph., consists in subjecting a substance, or a mixture of substances in powder, contained in a vessel called a **Percolator,** to the solvent action of successive portions of a certain menstruum, in such manner that the liquid, as it traverses the powder in its descent to the receiver, shall be charged with the soluble portion of it

and pass from the percolator free from insoluble matter, this product being termed the **Percolate**.

This process is also called **displacement**, because it is based upon the principle that the solvent after being charged with the soluble constituents of the drug, is **displaced** by fresh portions of the solvent liquid; partly from its own weight, partly from the pressure of the supernatant liquid; it continues to be displaced until the process is interrupted.

By continuing the supply of the solvent, which is termed **menstruum** (plural, **menstrua**) when used in extraction, the displacement of the liquid in which the soluble matter is in solution may be effected until no more is to be dissolved from the drug, when it is said to be **exhausted**.

The exhaustion of a drug is generally determined by the absence of color and taste of the percolate.

With resinous drugs exhaustion may be conveniently determined by mixing a few drops of the percolate with water; if exhausted, the percolate will not turn the water milky. In percolating drugs containing alkaloids, complete exhaustion has been effected when the percolate does not show any precipitation with reagents for alkaloids.

This process is called **simple percolation**, and is the process usually followed in the preparation of tinctures, wherein the quantity of menstruum is largely in excess of the drug to be exhausted.

When employed, however, for more concentrated preparations, viz., Fluid Extracts, where the volume of the product must correspond with the quantity of drug used in the extraction **measure for weight**, it is necessary to concentrate the percolate. The first three-fourths portion of percolate contains nearly a corresponding proportion of the principles of the drug, while the remaining one-fourth of the soluble matter requires usually a much greater amount of menstruum before it can be displaced. The three-fourths portion of the percolate is, therefore, reserved, and extraction continued until the exhaustion is complete; the percolate thus obtained, being very dilute or weak, is concentrated to the required bulk, with the application of the least possible amount of heat, then mixed with the reserved percolate and with sufficient of the menstruum to make required measure. (See Preliminary Notices—Percolation U. S. Ph., p. l--liii.)

Fractional or Re-percolation, introduced by Dr. E. R. Squibb, is a process by which the drug may be exhausted **volume** for **weight**, without entailing evaporation.

It differs from simple percolation in that the drug is divided into four portions, and packed in as many different percolators; each portion is treated as in simple percolation, except that the weak percolate obtained from each is used to moisten and extract each succeeding portion, the first percolate being reserved and mixed finally with the percolate from the last percolator, when their combined volume corresponds to the weight of the drug.

To conduct percolation successful,y the following points must be observed:

(1) Appropriateness of the apparatus.
(2) Degree of fineness of the powdered drug.
(3) Care in the moistening and the packing.
(4) The use of proper menstrua.

The Percolation Apparatus employed is a vessel to contain the drug, a receiving bottle, and sometimes a tube to carry the percolate into the receiver without loss by evaporation, and to regulate the flow.

A **Conical Percolator** is a glass Funnel used for percolation when the product is not desired too concentrated, as in the extraction for Tinctures.

A **Cylindrical Percolator** is a cylindrical funnel whose sides are deeper proportionately than those of an ordinary funnel, its outlet tube, or "neck," being shorter and thicker. It is made of glass, tinned iron, earthenware or wood.

Glass percolators are to be preferred, because in packing the drug the operator is enabled to see the material from the outside, and thus obtain better results; also because the percolation can be observed in its various stages, and proper means taken to render it more effective if necessary. The rate of extraction and exhaustion, when completed, may easily be recognized; also when the menstrua has sunk below the surface of the drug, the necessity of replenishing will be at once noticed.

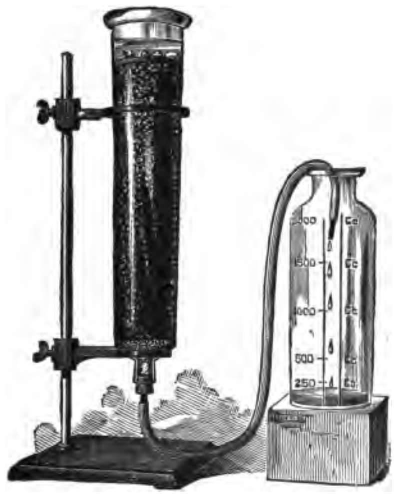
Tin percolators, though largely used, are in most instances objectionable, not only because they lack the advantages of glass, which alone should be sufficient to condemn their use, but also in that the material from which they are made is usually acted upon by drugs.

Wood and **earthenware** percolators are largely used in manufacturing, where glass would be too fragile or too expensive, for percolating drugs which would affect metal, or when chemical menstrua are used.

A Pressure Percolator is fitted with an air-tight cover through which the menstruum is supplied to the drug by a tube, connected with a reservoir containing the menstrua. The reservoir being placed high above the percolator, the liquid is forced through the drug by **hydrostatic pressure.** The "Anderson" and the "Suit's" are the best.

Percolators suitable for pharmacopœial quantities should be nearly cylindrical or slightly conical. The neck should be short and become gradually narrow at the opening in the percolator so as readily to admit the insertion of a cork with a glass-tube. Fitted to the tube is a piece of rubber-tubing, about one-fourth longer than the percolator itself. This is attached to the body of the percolator by a rubber band.

By raising the tube to the level of the liquid in the percolator, the flow is interrupted. By lowering the tube **the flow may be regulated** to be either **fast** or **slow.** For the **receiver,** any bottle will answer, but a graduated wide-mouthed bottle is the best. In the absence of a graduated "etched" bottle, one may easily be improvised by placing a narrow strip of cloth adhesive plaster lengthwise upon the bottle, measuring into it water by the cubic centimeter and then marking the strip carefully at the level of the water. A strip of paper pasted on the bottle may also be used, but it then requires a coat of varnish.



PERCOLATOR.

The rate of flow of the percolate for the pharmacopœial quantities should not exceed from ten to thirty drops per minute.

The proper fineness of drugs for percolation is very essential to the success of the process. If the drug is in too coarse a powder, exhaustion will not be complete; if too fine percolation may cease.

With most drugs, the degree of fineness of the powder suitable for percolation is directed by number (see "Sifting," Lecture II).

In drugs not officially recognized, the number of powder used should be the same as that of an official drug containing similar constituents. [For the general law and principles governing the degree of fineness of drugs for extraction, see "Comminution," Lecture II.]

Packing.—A drug should always be **moistened** and preferably allowed to macerate in order to **swell,** before packing it in the percolator.

The powdered drug, contained in a shallow dish, is uniformly sprinkled and then thoroughly mixed with sufficient menstruum to cause it to adhere in a mass when pressed in the hand, but not so wet that it will not readily break up and fall into a powder.

In **moistening** drugs containing a large proportion of soluble matter (extractive, gum, sugar, etc.) the powder agglutinates, especially if very fine, as in Cinchona and Rhubarb, forming small balls which cannot be rubbed to powder with the hands. Such moistened powder should be sifted through a coarse sieve, and the agglutinated particles rubbed through with the flat hand.

As a rule, the **more** extractive a drug contains, and the more **aqueous** the menstruum, the more difficult it is to moisten.

Conversely, the **less** extractive in the drug, and the more **alcoholic** the menstruum, the easier it is to moisten, and therefore the less care is required.

This is also true of packing the powder in the percolator. With the first-mentioned class great care must be taken that the powder be dropped successively in small quantities, and that the pressure in packing be not so great as to cause formation of compact layers of the drug, which could only be penetrated by the menstrua with great difficulty, if at all. On the other hand, with the latter class, containing less extractive and requiring alcoholic menstrua, such as Buchu, Cubeb, Ipecac, etc., the packing may be done much more quickly and with less care, since these powders are easily penetrated by the alcoholic menstrua.

In packing the powdered drug the following procedure should be observed:

First, prepare the percolator by inserting a piece of cotton in the neck, and of such size that it covers the bottom of the percolator. Upon this a piece of filter paper, cut round and ''nicked,'' is carefully laid so as to extend a half-inch up the sides, being first moistened with the menstruum, and then a thin layer of fine sand. The first portion of powder is then carefully introduced to guard against any falling between the filtering media, distributed evenly, and gently pressed. With the second portion the pressure is somewhat increased and continued with each successive portion until all the powder is packed.

For **packing,** a clyindrical piece of wood, cut square at the end, is used. The powder is now covered with a disk of paper or cloth, upon which are placed a few pieces of glass or similar heavy material to keep it in place. The menstruum is then poured in, a sufficient quantity constantly being supplied to keep the surface of the powder covered until the percolate begins to flow at the end of the tube, when the percolator should be carefully covered and set aside, if maceration is directed or deemed necessary.

Maceration.—It is not necessary to continue maceration more than 24 hours with drugs containing little extractive, but with drugs containing more, and such as contain alkaloids, extracted with difficulty, i. e., Cin-

chona, Hyoscyamus, Nux Vomica, etc., the maceration may be prolonged for three or four days.

The menstruum (plural, **menstrua**) or the liquid used for extraction, is usually Alcohol, or Alcohol diluted with Water in various proportions, sometimes with an addition of Glycerin. When the greater proportion is water, the menstruum is generally said to be **aqueous**; when Alcohol is the greater, it is termed an **alcoholic** menstruum.

Chemical solvents are sometimes employed for the more effective extraction of drugs whose principles are soluble with difficulty in **neutral** menstrua.

Alkaline menstrua are employed with resinous or acid drugs, such as Glycyrrhiza and Rhubarb, and **acid menstrua**, when the active principles consist of Alkaloids, as in Cinchona, Conium and Nux Vomica.

The menstruum should be selected with reference to its **solvent power** and its adaptability to hold the extracted matter **permanently** in solution, or to prevent precipitation.

The **character** and **solubility** of the constituents of the drug must be known to insure the use of the best solvent.

As a general rule, therefore, alkaloidal, resinous and oleo-resinous drugs require **alcoholic** menstrua.

Acid and extractive drugs require **aqueous** menstrua. There are, however, some exceptions to this rule, and the menstrua directed in the U. S. Ph. should be used in all official preparations.

In some drugs the constituents vary greatly as regards solubility, since they contain at once oils, acids, and alkaloids, all possessing medicinal value.

In such cases it is difficult to select such menstrua as will extract, all these constituents without their subsequent precipitation in the percolate.

Glycerin is here well adapted as a medium, since it possesses **intermediate** solvent properties between alcohol and water, as it dissolves to a great extent all the principles soluble in either alone. The use of glycerin should be confined to menstrua having only the above purpose in view.

The **displacement** of the menstrua with weak alcohol or water should not be attempted until the greater portion of the extract has been obtained. It is best to begin with a liquid slightly less alcoholic in strength, and then gradually increase the proportion of water until finished. With drugs containing considerable gum, starch, etc., liable to swell, great care must be taken, that water be not used too early in the process.

QUESTIONS ON LECTURE III.—SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink,** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all the rules of the "Important Notice" must be complied with.

THE DIRECTOR.

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1. Distinguish between Solution, Diffusion and Absorption.
2. State the difference between **simple** and **chemical solution.**
3. How is the temperature of the solvent affected by solution?
4. How does Heat **promote** solution?
5. Describe the **method** of Circulatory Displacement.
6. What are the **five** most common solvents?
7. How is the Solubility of a Substance expressed? Give example.
8. Of what advantage is Solubility in defining articles in the Pharmacopoeia?
9. At what temperature are the solubilities referred to in U. S. Ph. viii.
10. Define Osmosis. Dialysis.
11. Distinguish between Filtration and Straining.
12. What **conditions** favor Filtration?
13. Fold a Filter Paper as directed, **sign** with your Name, and **forward with your Answers.**
14. Name the most **common** filtering Media.
15. Name three ways by which crystals may be formed.
16. What is meant by Crystallization?
17. Name and describe the common **shapes** of Crystals.
18. Distinguish between **Amorphous and Crystalline.**
19. What is a **saturated** Solution?
20. Describe the process of Percolation.

21. What **conditions** favor successful Percolation?

22. What should be the rate of flow for a good percolation?

23. How may the fact that a Drug is exhausted be **determined**?

24. What is meant by **fractional** Percolation?

25. What is an Infusion? A Decoction.

26. What class of Drugs are best adapted to Infusion? to Decoction?

27. Distinguish between **Maceration** and **digestion.**

28. When is the use of Glycerin indicated in the Menstruum?

29. What **properties** should characterize a Menstruum?

30. Why should Drugs be macerated **before** packing in the percolator?

31. Why is Infusion of Wild Cherry prepared by maceration in **cold** Water?

32. Mention the two kinds of Clarification and the **agents** used in each.

33. What class of preparations prepared by extraction represents the drug, **volume** for **weight.**

34. In what different ways may extraction of a drug be effected?

35. What vessels should **not** be used in making Infusions and Decoctions?

INORGANIC PHARMACY.

This division comprises the **inorganic** substances, their Compounds and Preparations.

They will be treated with reference to their derivation and production, their purification and preparation, their pharmaceutical and medicinal properties and uses, and also their domestic and technical uses.

The chemical theories and principles involved are not particularly treated here, but are reserved for the Lectures on Chemistry. Nevertheless, the various processes employed in the production and preparation of Chemical substances, the reactions involved and their physical and chemical characters and properties, are sufficiently explained to render the study comparatively easy. It is assumed that every student has a general knowledge of chemistry, however slight, and this should be extended by reference to some text-book on chemistry in conjunction with the study of these Lectures.

The following terms are used quite frequently and the respective distinctions should be carefully observed:

Molecule, meaning the smallest particle of matter that can exist by **itself,** and **Atom** which is the smallest quantity of matter into which a **Molecule** may be divided, or the smallest quantity of matter that can enter into combination to produce a Molecule;

Elements, which include the **Gases,** such as Hydrogen, and which are, in Chemistry, indicated by **Symbols,** as H for Hydrogen, Fe for Iron (Ferrum), Cl for Chlorine, etc.; the **non-metals,** or metalloids, such as Iodine, Bromine; the **metals,** such as Iron, Copper, Lead; the **alkali metals,** Potassium, Sodium, and the **alkaline earths,** Calcium, Magnesium, etc.

A **Compound** is the product of two or more of these elements, which may be an **Acid,** a **Base** or a **Salt.**

A **Preparation** is the particular **form** given to an element or a compound by dissolving it or mixing it with a substance for certain uses. It differs from a compound in that while the latter is the product of different elements, possessing new and distinctive properties from the Elements from which it was made, the substances that enter into a **preparation** do not lose their chemical properties, but are simply changed in form.

Thus Potassium Iodide is a **compound** of Iodine (and Potassium), but Tincture of Iodine is a **preparation** of Iodine; Sulphuric Acid is a **compound** of Sulphur, but Precipitated Sulphur is a **preparation**, or **form** of Sulphur.

The distinction is the same as that between a **compound,** or chemical, solution and a **simple** solution. In the former instance a chemical change takes place, in the latter a physical change only.

Compounds are indicated by Chemical **Formulas.** For instance, H_2O is the Formula for Water, meaning that Water is a Compound consisting of two **Atoms** of Hydrogen and one **Atom** of Oxygen; H_2SO_4 is the Formula for Sulphuric Acid, indicating that this substance is a Compound consisting of two **Atoms** of Hydrogen, one of Sulphur and four of Oxygen.

The preparations, being regarded more especially as pharmacal products, are mostly treated separately in a succeeding Lecture, according to their respective classes, i. e., Waters, Solutions, Spirits. There are some exceptions to this rule, and under each element and compound the respective preparations are always enumerated and often completely described.

COMPOUNDS OF HYDROGEN AND OXYGEN.

Water.—H_2O.—Aqua, U. S., potable water in its purest attainable state.

A colorless, limpid liquid without odor or taste at ordinary temperature and remaining odorless when heated.

Water should be free from metallic impurities and should not contain more than 0.05% of Soluble Salts. The U. S. Ph. fixes certain limits for the presence of these, including Sulphates, Chlorides, Nitrates, Nitrites, Ammonia and Organic Substances.

Water may be purified by filtration through Animal Charcoal and Sand and by **precipitation** with Alum (Alum. et Potass Sulph.) or Ferric Chloride.

The following adjectives are used to designate different kinds of water: **pura,** pure; **fluvialis,** river; **pluvialis,** rain; **fontana,** fountain; also with reference to its temperature: **frigida,** cold; **fervida,** hot; **bullientis,** boiling.

From water the following are prepared:

Distilled Water.—Aqua Destillata, U. S.—From 1,000 volumes of water the first 100 volumes are rejected and of the remainder 800 volumes are collected by distillation.

It should be preserved in loosely-stoppered containers.

Medicated Waters, Aqua Medicata.—The official class of waters; also:

Hydrogen Dioxide Solution.—Aqua Hydrogenii Dioxidii, U. S. —Solution of Hydrogen peroxide. A slightly acid, aqueous solution of Hydrogen Dioxide, H_2O_2, containing about 3 per cent of pure Dioxide corresponding to about 10 volumes of available oxygen.

Peroxide of Hydrogen is made by decomposing Barium Dioxide with Phosphoric Acid, freeing the solution from Barium Phosphate by precipitating it as insoluble Barium Sulphate with Sulphuric Acid.

Properties and Uses.—As a ready source of oxygen for bleaching and antiseptic purposes. It should be kept in loosely-stoppered bottles in a cool place to prevent the disengagement of the oxygen which may otherwise result in explosion.

THE INORGANIC ACIDS.

Acids, whether **organic** or **inorganic,** except in the case of the so-called **haloid** acids, like Hydro-chloric Acid, are built on the type of the water-molecule, and consist of an Atom or a group united by Oxygen to Hydrogen. If we represent the water-molecule thus: H—O—H, which, it will be noted, is equivalent in Atomic construction to H_2O, the ordinary method of writing the Formula, an acid molecule would be represented thus: X—O—H, X representing the atom or group of atoms.

Character and Properties.—Acids are characterized by possessing a **sour** taste, by the property of changing certain vegetable **blues,** like blue litmus, to **red** and by the power they have of combining with **bases** to produce **salts.**

Some acids are **mono**-basic, that is, are built on the plan of one water-molecule, and have one replaceable hydrogen atom, as Nitric Acid, H—O—(NO_2), ordinarily written HNO_3; others are **di**-basic and have two replaceable hydrogen atoms as Sulphuric Acid $\begin{matrix}H-O\\H-O\end{matrix}>(SO_2)$, ordinarily written H_2SO_4; and some other acids have a still higher **basicity.** The phenomenon of the replaceability of Hydrogen is more fully explained in the succeeding paragraphs.

In the inorganic acids the **number** of Hydrogen atoms in the formula indicates the **basicity** of the acid, but this is not always true of the organic acids, since one or more hydrogen atoms may enter into the constitution of the complex negative radical. Inorganic acids, or, as they are also called, "Mineral Acids," with but **one** Hydrogen atom can form but **one** series of Salts by combining with Bases, but those that have **two** or more Hydrogen atoms may form **two** or more series, according as all or only a part of the Hydrogen atoms are replaced by the basic Radical.

For example, Sulphuric Acid, H_2SO_4, may react upon Soda and produce, under different circumstances, two different salts. In case both its Hydrogen atoms are replaced by Sodium (Na, natrium), neutral Sodium Sulphate Na_2SO_4, will be produced, but if only one of the Hydrogen atoms is replaced by the Sodium, Acid Sodium Sulphate $HNaSO_4$ will be produced. The latter salt still possesses acid properties.

The Haloid Acids differ from the other in molecular plan by having the negative Radical directly united to Hydrogen without the mediation of an Oxygen atom, as Hydrochloric Acid, HCl, Hydrobromic Acid, HBr, Hydriodic Acid, HI, and Hydrofluoric Acid, HF. These Acids form a corresponding series of Salts by uniting with Bases. Common salt, NaCl, is an illustration.

Some of the acids are solid, some liquid, and some gaseous at ordinary temperatures.

Solid Acids.—Arsenous, Boric, Chromic and Glacial Phosphoric Acid. Arsenous and Chromic Acids are not true acids, but trioxides; these will be considered with their respective Elements. There are eight official Organic Acids that are solid and three that are liquid.

Liquid Acids.—Nitric, Nitrohydrochloric, Phosphoric, Hypophosphorous, and Sulphuric; also official Hydrochloric acid and all **dilute** acids.

Gaseous Acids.—Hydrobromic, Hydrochloric (Hydrofluoric not official), Sulphurous and Carbonic Acid and Hydrocyanic Acid which may be here included.

General Properties and Uses of Inorganic Acids.

The chief inorganic acids occur commercially in three different forms, designated with reference to their strength and purity, viz.:

"Com.," Commercial, for industrial uses.

"U. S. P.," Responding to the tests for purity and strength of the U. S. Ph., for medicinal and pharmacal purposes and

"C. P.," Chemically pure, when a degree of purity higher than the U. S. Ph. degree is required for analytical tests and reactions.

This designation has become so meaningless, however, that it is being superseded by that of "analyzed" or "certified," showing exactly what impurities, if any, the acid or chemical may contain.

The **strengths** of liquid acids are designated by the **percentage by weight** of real, or anhydrous acid, determined by the specific gravity at 25° C. (77° F.) and by the number of C.C. of the V. S. (volumetric solution) of Potassium Hydroxide required to exactly neutralize a given number of C.C. of the acid. (Refer to U. S. Ph., Volumetric Solutions, p. 544.)

Preservation and Handling.—Especial care should be used in storing acids in a cool place, as they expand by heat, some volatilize and some are liable to freeze and expand through extreme cold (as Sulphuric Acid) and burst the container. They should always be kept in glass-stoppered containers and care must be observed in loosening the stopper should it become tightly fixed in the bottle.

Pharmacal Uses.—As chemical solvents and precipitants; for the preparation of their respective compounds and the Dilute Acids; for corroding, etching and many other purposes in the arts and manufactures.

Medicinal Uses and Antidotes.—To counteract alkalinity in the system; to

increase the action of alkaloids and to furnish refrigerant draughts, for which organic acids are, however, mostly used. The corrosive action of concentrated acids taken internally is counteracted by the administration of carbonates of calcium and magnesium, oil, soap and demulcent liquids.

THE HALOID ACIDS.

These include the acids of Bromine, Chlorine, Iodine and Fluorine.

Hydrobromic Acid.—Acidum Hydrobromicum.—A haloid acid having the formula HBr.

Preparation.—It is made by causing Water to react on Phosphorus Bromide as expressed in the following equation:

$$PBr_5+4H_2O=5HBr+H_3PO_4.$$

The hydrobromic acid is separated from the phosphoric acid by distillation.

Also made by decomposition of Potassium Bromide with Sulphuric Acid, the Potassium Sulphate allowed to crystallize and the acid separated by distillation:

$$\underset{\text{Pot. brom.}}{2KBr} + \underset{\text{Acid sulph.}}{H_2SO_4} = \underset{\text{Pot. sulph.}}{K_2SO_4} + \underset{\text{Acid.}}{2HBr.}$$

Properties.—A colorless gas, with a strong, irritating smell, and an acid taste and reaction. It liquefies only at the low temperature of —73°C. and becomes a colorless solid at —87°C. It fumes on exposure to the air, as also does its aqueous solution. Like hydrochloric acid, it has a strong affinity for water, and dissolves in it in very large proportion. It is the aqueous solution which is used in medicine, and to which the name, hydrobromic acid, is usually applied. The aqueous solution that contains 49.8 per cent of the acid gas has a sp. gr. of 1.515.

Diluted Hydrobromic Acid.—Acidum Hydrobromicum Dilutum, U. S.—A liquid composed of 10 per cent by weight of absolute Hydrobromic Acid and 90 per cent water. Sp. gr. 1.076.

It is readily distinguished from hydrochloric acid by the addition of chlorine water, which sets free the bromine. It should be preserved in glass-stoppered bottles.

Medicinal Uses.—Chiefly administered in place of Bromides.

Average Dose 4cc. (1 fl.dram).

Hydrochloric Acid.—HCl.—Acidum Hydrochloricum, U. S.—A liquid composed of 31.9 per cent by weight of absolute Hydrochloric Acid and 68.1 per cent of water. Sp. gr. 1.158.

This is also a haloid acid, and, like hydrobromic acid, absolute hydrochloric acid is gaseous at ordinary temperatures, and it is the aqueous solution that is used in the arts, and to which the name Hydrochloric, or "Muriatic," Acid is applied.

Source.—The pure acid gas is obtained by treating pure Common Salt with pure Sulphuric Acid, according to the following equation:

$NaCl$	+	H_2SO_4	=	$HNaSO_4$	+	HCl.
Sodium chloride.		Sulphuric acid.		Sodium sulphate acid.		Hydrochloric (acid).

and collecting the gas over mercury or by the displacement of air. The aqueous hydrochloric acid is obtained by passing the gas into water, the latter liquid absorbing it in large quantities.

Character and Properties.—The gaseous hydrochloric acid is intensely irritating to the air passages, and strongly acid in its chemical reaction. It is condensable to a liquid at a temperature —4°C. and a pressure of 25 atmospheres. Its sp. gr., taking air as the standard, is 1.278.

The official Hydrochloric Acid is a colorless, fuming liquid, intensely acid to the taste and in its chemical behavior, and possesses a pungent suffocating odor. Heated with Manganese Dioxide it evolves Chlorine, and in a solution of Silver Nitrate it produces a curdy white precipitate.

Uses.—In the preparation of various official Chlorides; with Nitric Acid to form Nitro-Hydrochloric Acid; for generating Chlorine; and in promoting the precipitation of Resins. It is sometimes administered internally, and is sometimes used externally for its irritant or caustic effects.

Also in the preparation of Solutions of: Arsenic Trioxide, Ferric Chloride and Zinc Chloride.

Diluted Hydrochloric Acid.—Acidum Hydrochloricum Dilutum, U. S., contains 10 per cent of absolute Hydrochloric Acid. Sp. gr. 1.049.

It is made by mixing 100 Gm. official acid with 219 Gm. of Distilled Water.

Hydrofluoric Acid.—HF.—Acidum Hydrofluoricum. A haloid acid. Not official.

Obtained by distilling powdered Fluor-spar with Sulphuric Acid in a leaden retort, and condensing the vapors in water. Great care should be observed in the process not to breathe the vapors, as they are highly irritant and poisonous.

Properties.—Hydrofluoric Acid is a colorless, mobile, fuming liquid, lighter than water, and highly volatile. It boils at 19.4°C., and is very soluble in water. A solution whose sp. gr. is 1.15 contains 35.37 per cent of hydrofluoric acid and is the kind usually employed in the arts. It is an extremely caustic liquid, and must be preserved in bottles made of guttapercha or lead. Its principal use is for etching on glass.

Hydriodic Acid.—HI.—Acidum Hydriodicum. A haloid acid. Not official.

Made by decomposing Iodine in solution with Hydrogen Sulphide, or by double decomposition of an Iodide and an Acid.

Diluted Hydriodic Acid.—Acidum Hydriodicum Dilutum, U. S. —Contains 10 per cent of absolute Hydriodic Acid—HI—and 90 per cent of water.

It is made by decomposing Potassium Iodide with Tartaric Acid in the presence of Alcohol, whereby the Acid Tartrate of Potassium is precipitated, and the HI is obtained in solution in Water, after it has been separated from the precipitate and the Alcohol has been volatilized. A little Potassium Hypophosphite is added to prevent liberation of Iodine during the reaction.

Average Dose: 1cc. (15 minims).

Syrup Hydriodic Acid.—Syrupus Acidi Hydriodici, U. S.—A Syrupi liquid containing 1 per cent by weight of HI. Made by mixing Acid Hydriodic dilate 10 Gm.; Water 30 Gm. and Syrup to Gm. 100.

Should be kept in small well-filled bottles.

Average Dose: 4cc. (1 fldrm.).

THE OXYGEN ACIDS.

The elements Nitrogen, Phosphorus and Sulphur form acids by uniting with both Oxygen and Hydrogen and these are therefore called **oxyacids** in distinction to the **hydracids,** which the haloid acids sometimes are termed. They comprise Nitric, Phosphoric, Hypophosphorous, Sulphuric and Sulphurous Acids; also the acid of Boron.

Nitric Acid.—HNO_3.—Acidum Nitricum, U. S.—A liquid composed of 68 per cent by weight of absolute Nitric Acid and 32 per cent of water. Sp. gr. 1.403.

It is usually obtained by reacting on Sodium or Potassium Nitrate with Sulphuric Acid. The reaction is represented by the following equation:

KNO_3	+	H_2SO_4	=	$KHSO_4$	+	HNO_3.
Potassium nitrate.		Sulphuric acid.		Potassium sulphate (acid).		Nitric acid.

The process is conducted in iron or glass-retorts and the acid is obtained by distillation.

Properties.—The strong acid is a fuming, very caustic and corrosive liquid, of a pungent, suffocating odor, and strongly acid reaction. It rapidly absorbs moisture from the air, and on account of this and its corrosive properties must be kept in tight-fitting glass-stoppered bottles. It acts powerfully on organic tissues, and colors such substances as horn, hair, skin, nails, wool and silk a bright yellow color. It acts energetically on copper, evolving in the process red fumes of nitrogen tetroxide, and yielding a green solution of copper nitrate.

Uses.—For dissolving various metals; as an oxidizing agent; for preparing certain nitrates; in the preparation of Nitrous Ether and Amyl Nitrite and in medicine to some extent as a caustic.

Diluted Nitric Acid.—Acidum Nitricum Dilutum, U. S.—Contains 10 per cent by weight of absolute Nitric Acid. Sp. gr. 1.054.

Made by mixing 100 Gm. Nitric Acid with 580 Gm. Distilled Water.

Nitrohydrochloric Acid.—Acidum Nitrohydrochloricum, U. S. —A mixture of 18 volumes of Nitric Acid and 82 volumes of Hydrochloric Acid; called Aqua Regia, because of its power to dissolve gold.

The acids, when mixed, should be kept in glass-stoppered bottles, not more than half-filled. The liquid assumes a golden color and gives off chlorine gas to which its power of dissolving gold is due.

It is also called Nitromuriatic Acid.

Average Dose: 0.2 cc. (3 minims).

Diluted Nitrohydrochloric Acid.—Acidum Nitrohydrochloricum Dilutum, U. S.—A mixture of 4 volumes of Nitric Acid, 18 volumes of Hydrochloric Acid, and Distilled Water 78 volumes.

The water is added to the acids after the reaction has ceased.

It is given internally in conjunction with bitter tonic medicines.

Average Dose: 1 cc. (15 minims).

Acids of Phosphorus.

There are five different acids of phosphorus:

Hypophosphorous acid, HPH_2O_2.
Phosphorous acid, H_3PO_3.
Orthophosphoric acid, H_3PO_4.
Pyrophosphoric acid, $H_4P_2O_7$, and
Metaphosphoric acid, HPO_3.

Those of most importance to the pharmacist are Metaphosphoric Acid, or the so-called "Glacial" Phosphoric Acid, the official Orthophosphoric Acid, and Hypophosphorous Acid.

Metaphosphoric Acid.—HPO_3.—Glacial Phosphoric Acid. This may be obtained from ordinary or orthophosphoric acid by heating it until water is no longer given off, according to the equation:

$$H_3PO_4 = HPO_3 + H_2O.$$

In practice, it is usually obtained by treating calcined bones (Calcium Phosphate) with dilute Sulphuric Acid, neutralizing the filtered liquid with ammonia and evaporating the liquid freed from the precipitate to dryness and heating to redness. The fused acid is poured upon polished iron-plates and obtained in flat pieces or molded into pencils. The acid thus prepared, though containing some sodium, is sufficiently pure for some of the purposes of pharmacy.

Phosphoric Acid.—Orthophosphoric Acid—H_3PO_4—Acidum

Phosphoricum, U. S.—A liquid composed of not less than 85 per cent by weight of absolute Orthophosphoric Acid and 15 per cent of water. Sp. gr. 1.707.

It is prepared from Phosphorus and Nitric Acid in the presence of Water; by the aid of heat the Phosphorus is oxidized by the Nitric Acid, the excess of Nitric Acid driven off and the liquid concentrated by evaporation.

Properties.—The official acid is a colorless odorless liquid, with a strongly acid taste and reaction. When heated gradually it loses water until, when a temperature of about 200°C. is reached, decomposition occurs and it is converted first into a mixture of pyrophosphoric and metaphosphoric acids, and finally into metaphosphoric acid.

Tests.—Metaphosphoric and orthophosphoric acids are readily distinguished from each other when in solution, by the following tests: **Metaphosphoric** acid yields with nitrate of silver a transparent gelatinous precipitate, with barium and calcium chlorides white precipitates, and it has the property of coagulating albumen.

Orthophosphoric acid, if ammonia be added, yields with nitrate of silver a yellow precipitate, does not form precipitates with either calcium or barium chlorides, and does not coagulate albumen.

Diluted Phosphoric Acid.—Acidum Phosphoricum Dilutum, U. S.—Contains 10 per cent of Orthophosphoric Acid. Sp. gr. 1.057.

Made by mixing 100 Gm. official acid with 750 Gm. Distilled Water.

Uses.—In Syrup of the Phosphates of Iron, Quinine and Strychnine and several unofficial preparations, such as Compound Solution of Phosphates, etc.

In weak solutions containing an excess of phosphoric acid a fungoid growth is formed which cannot be prevented except by the addition of a little hydrochloric acid; it may be retarded, however, by keeping such preparations in small, well-filled bottles, in a dark place.

Hypophosphorous Acid.—$PO.H_2(OH)$.—Acidum Hypophosphorosum, U. S.—A liquid composed of 30 per cent of absolute Hypophosphorous Acid and 70 per cent of Water. Sp. gr. 1.13.

The process consists of mixing a solution of Potassium Hypophosphite with an alcoholic solution of Tartaric Acid. Potassium Tartrate, soluble in alcohol, precipitates, the Hypophosphorous Acid is set free and may be obtained in solution of the desired strength by evaporating the alcohol and diluting the liquid with distilled water to the required measure.

Uses.—As a substitute for Hypophosphites.

Average Dose: 0.5 cc. (8 minims).

Diluted Hypophosphorous Acid.—$PO.H_2(OH)$.—Acidum Hypophosphorosum Dilutum, U. S.—A liquid composed of about 10 per cent by weight of absolute Acid and 90 per cent water. Sp. gr. 1.042.

The acid is formed, combined as hypophosphite, when Phosphorus is

boiled with Calcium, or other Alkaline Hydrates, in water, from which it is obtained by decomposing the hypophosphite with a stronger acid.

THE ACIDS OF SULPHUR.

Sulphuric Acid.—H_2SO_4—Acidum Sulphuricum, U. S.—A liquid composed of not less than 92.5 per cent by weight of absolute Sulphuric Acid and not more than 7.5 per cent of water. Sp. gr. 1.826.

This is the most important and useful of all acids; it is used in almost innumerable processes in the chemical arts; by means of it the great majority of the other acids are prepared; and its manufacture constitutes a very important branch of modern industry. The compounds of sulphuric acid or Sulphates, are very numerous and important, some of them existing in nature and others being products of the laboratory.

Sources.—The acid may be obtained by the "roasting" of sulphides, such as iron pyrites, or by burning Sulphur in a leaden chamber so arranged that the fumes, Sulphur Dioxide, SO_2, come in contact with water, H_2O, in the form of vapor, and Nitric Acid, HNO_3:

$$2HNO_3+2SO_2+H_2O=2H_2SO_4+N_2O_3.$$

The nitrogen trioxide, N_2O_3, combines with Water and Oxygen and Sulphur Dioxide to form Sulphuric Acid with the liberation of the trioxide. This Nitrogen Trioxide acts as a continuous carrier of Oxygen from the Air to the Dioxide, being re-formed as soon as the Sulphuric Acid is produced.

The nitrogen trioxide is generated by the action of Sulphuric Acid on crude Sodium Nitrate, and it is evident that a small quantity of it will suffice for the production of a large quantity of Sulphuric Acid. The acid porduced by this process is allowed to accumulate in the bottom of the leaden chamber until it acquires a specific gravity of 1.55 and contains about 64 per cent of pure acid. This liquid, further concentrated in leaden evaporating pans until it acquires a specific gravity of 1.71 and contains 78 per cent of real acid, constitutes the common brown "Oil of Vitriol" of commerce.

Further concentration of the acid is effected by distillation in platinum.

Purification.—The product thus obtained not only contains considerable water but also frequently Arsenic derived from the sulphur ores used in generating the SO_2, and Lead Sulphate derived from the leaden chamber and evaporating pans of the same material.

To get rid of these impurities the commercial product is distilled in glass retorts until about one-third is passed over. The receiver is now changed and the remainder distilled nearly to dryness. The product thus obtained is free from the other impurities, but still contains some water which cannot be got rid of by distillation.

Properties.—The pure acid thus obtained is an inodorous, colorless, and oily-looking liquid of strong acid reaction, and is intensely corrosive and caustic. It is miscible in all proportions with water and alcohol, and the mixture develops considerable heat; for this reason the acid should be poured into the water instead of the reverse when these are mixed. As it has a strong affinity for water, it chars or blackens many organic substances, as sugar, by abstracting from them the elements of water, especially when heated with them. It reacts so violently with volatile oils, such as Oil of Turpentine, as to sometimes cause explosion.

The impurities of the acid and their detection are fully described in the U. S. Ph.

Aromatic Sulphuric Acid.—Acidum Sulphuricum Aromaticum, U. S.—Elixir of Vitriol—A mixture of Sulphuric Acid, 111 cc; Tinct. of Ginger, 50 cc; Oil of Cinnamon, 1 cc, and Alcohol enough to make 1000 cc. Sp. gr. 0.933, contains 20 per cent absolute Sulphuric Acid by weight, partly in the form of Ethyl-Sulphuric Acid.

The directions given in the U. S. Ph. to add the sulphuric acid **gradually to** 700 parts of alcohol should be followed explicitly, for if the alcohol be added to the sulphuric acid, or if the sulphuric acid be added rapidly to the alcohol, accidents are liable to occur from the great heat developed.

Average Dose: 2cc. (30minims).

Diluted Sulphuric Acid.—Acidum Sulphuricum Dilutum, U. S. —Contains 10 per cent by weight of Sulphuric Acid. Sp. gr. 1.067. Made by mixing 100 Gm. of the official acid with 825 Gm. Distilled Water.

Uses.—In the preparation of alkaloids, ether, pyroxylin, parchment, etc. Also in the manufacture of acids, such as acetic, nitric, citric and tartaric; having a strong affinity for bases, it unites with them when added to their salts and sets the weaker acid free—as for example, carbonic acid from carbonate of lime or soda in the making of "soda water." Also for decomposing certain organic compounds, as in purification of chloroform; and for forming sulphates.

Fuming Sulphuric Acid, or "Nordhausen Acid," for some purposes in the arts is preferred to the ordinary acid; a thick, oily fuming liquid of a sp. gr. from 1.86 to 1.89. It consists of a mixture or perhaps a combination of the ordinary sulphuric acid, H_2SO_4 with sulphuric anhydride, SO_3, and is obtained by distilling in earthenware retorts basic Ferric Sulphate, $Fe_2S_2O_9$, the product of roasting common Green Vitriol, $FeSO_4+7H_2O$.

Sulphuric Anhydride, SO_3, is a substance obtained by passing Sulphurous Anhydride, SO_2, mixed with Oxygen over platinum sponge or platinized asbestos heated to redness. It may also be obtained by distillation of Nordhausen Acid.

It exists in two modifications. One consists of transparent prisms which melt at 16°C., and on agitation solidifies at the same temperature. If the melted prismatic crystals be permitted to stand at a temperature a little below 25°C., a mass of silky needles will be formed which do not melt at a temperature below 50°C. They change back to the first modification, however, when melted. In the second form SO_3 does not redden litmus paper (unless the latter be damp); it may be handled with impunity with dry hands, and does not attack the metals unless moisture be present. If thrown into water it hisses like a hot iron, great heat is developed and H_2SO_4 is formed. For convenience and transportation and on account of its purity, it has been proposed to manufacture it on a large scale for most purposes for which pure sulphuric acid is required.

Sulphurous Acid.—H_2SO_3.—Acidum Sulphurosum, U. S.—A liquid composed of not less than 6 per cent by weight of Sulphurous Acid Gas (Sulphur Dioxide, SO_2) and 94 per cent of Water. Sp. gr. 1.028.

It may be formed in various ways:

(1) When Sulphuric Dioxide, SO_2, is brought into contact with Water.

(2) When Sulphur is burned in the air: $S+O_2=SO_2$.

(3) Certain Metals, as copper, acted upon by Sulphuric Acid: $Cu+2H_2SO_4=CuSO_4+2H_2O+SO_2$.

(4) Sulphur and Sulphuric Acid heated together: $S+2H_2SO_4=3SO_2+2H_2O$.

(5) By the decomposition of a Sulphite by Sulphuric Acid: $Na_2SO_3+H_2SO_4=Na_2SO_4+H_2O+SO_2$.

(6) By heating Charcoal and Sulphuric Acid together: $C+2H_2SO_4= H_2O+CO_2+2SO_2$.

It is the latter process which is adopted in the U. S. Ph. The gas thus obtained is passed through a wash bottle and collected in a bottle containing distilled water, in which it is dissolved.

Properties.—A Saturated Solution of the Gas in Water, it is a colorless liquid of a pungent, stifling odor, strongly acid taste and reaction, which first strongly reddens and then bleaches litmus paper.

Uses.—In the manufacture of sulphites and as a bleaching agent in the arts and industries; in medicine chiefly for its powerful antiseptic and disinfecting properties.

THE NON-METALS.

The **non-metals** comprise those elements which lack the specific physical characters or properties of the **metals**, such as expansibility, elasticity, tenacity, malleability and ductility.

They are **gaseous**, as Hydrogen, Chlorine; **liquid**, as Bromine, and **solids**, which may be hard and brittle, such as Carbon and Sulphur, or soft and unstable, such as Phosphorus.

Only the elements themselves and their preparations will be here described, their acids having already been treated, and their other compounds, being, as a rule, described under their

respective bases; for example: Sodium Chloride under Sodium; Potassium Bromide under Potassium; Mercuric Iodide under Mercury, etc.

The non-metals, or **metalloids**, as they are also preferably called (from **oid**, Gr., like), are usually divided into four groups according to their property of combining with **one, two, three** or **four** atoms of Hydrogen to form a volatile compound, as follows:

1. Hydrogen, Chlorine, Bromine, Iodine and Fluorine.
2. Oxygen, Sulphur, Selenium and Tellurium.
3. Nitrogen, Phosphorus and Arsenic.
4. Boron, Carbon and Silicon.

Of these the compounds of Hydrogen and Oxygen have already been described, and the compound of Nitrogen with Hydrogen, known as the radical, NH_3, Ammonia, may, because of its character, be considered with the **alkalies.**

Of the elements Selenium and Tellurium there are no compounds of importance.

Chlorine—Cl.

The element Chlorine is a gas which does not occur in a free state in nature, but its compounds are numerous and important.

It is really obtained by the reaction of Hydrochloric Acid on Manganese Dioxide, as represented in the following equation:

$$\underset{\text{Hydrochloric acid.}}{4HCl} + \underset{\text{Manganese dioxide.}}{MnO_2} = \underset{\text{Chlorine.}}{Cl_2} + \underset{\text{Manganese chloride.}}{MnCl_2} + \underset{\text{Water.}}{2H_2O}$$

It can also be obtained in many other ways.

Properties.—Chlorine is a greenish colored, disagreeable odorous gas, 2.45 times as heavy as air, and under a pressure of 6 atmospheres at 0°C. convertible into a yellow liquid having a sp. gr. of 1.33. The gas dissolves in about half its volume of cold water, unites with great energy with Hydrogen to form Hydrochloric Acid, and owing to its strong affinity for hydrogen is a powerful **bleaching** agent.

Preparations of Chlorine.

Chlorine Water.—Liquor Chlori Compositus, U. S.—Compound solution of Chlorine—An aqueous solution containing, when properly prepared, 0.4 per cent of Chlorine, with some chlorinated products and Potassium Chloride. Prepared by decomposing Potassium Chlorate with HCl in Water.

Uses.—As reagent in the pharmaceutical laboratory, and in medicine as an antiseptic and deodorant.

Average Dose: 4cc. (1 fldrm.).

Chlorinated Lime.—Calx Chlorinata, U. S.—Also wrongly called "chloride of lime," is a compound produced by the action of Chlorine on Calcium Hydrate and containing not less than 30 per cent of available Chlorine.

It has the odor of chlorine, and is a valuable bleaching agent, disinfectant and antiseptic. It should not be exposed to the air, but kept in airtight non-metallic containers.

Solution of Chlorinated Soda.—Liquor Sodæ Chlorinatæ, U. S. —(Labarraque's Solution) an aqueous solution of several chlorine-compounds of Sodium containing at least 2.4 per cent by weight of available chlorine.

Prepared by adding a solution of Sodium Carbonate to the liquid obtained by filtration from a mixture of Chlorinated Lime and Water.

Properties.—Clear, pale-greenish liquid, sp. gr. 1.050, odor of chlorine, disagreeable alkaline taste, and acting as a bleaching agent upon vegetable coloring matters.

Uses.—As a reagent in the pharmaceutical laboratory, and in medicine as a disinfectant and antiseptic, and as a bleaching agent; for the removal of fruit-stains, etc.

Chlorine is the most efficient as it is the most powerful of all disinfectants. It is also the cheapest, and in the form of a good article of chlorinated lime leaves nothing to be desired for all purposes of a general disinfectant and deodorizer.

BROMINE—Br.

Bromine is not found free in nature, but its compounds are not uncommon, occurring in combination with sodium, potassium silver, calcium, magnesium, etc. It occurs in Sea-Water and in the waters of many saline springs. It is usually obtained as a by-product in the manufacture of "Salt" by concentrating the mother liquor containing its salts, the "bittern," and treating it with Chlorine, which displaces the Bromine from its compounds, as represented in the equation:

$$\underset{\text{Magnesium bromide.}}{MgBr_2} + \underset{\text{Chlorine.}}{Cl_2} = \underset{\text{Magnesium chloride.}}{MgCl_2} + \underset{\text{Bromine.}}{Br_2}.$$

Bromine.—Br.—Bromum, U. S.—It should contain not less than 97 per cent of pure Bromine and be kept in protected glass bottles in a cool place. A heavy, mobile, very volatile liquid, with a disagreeable, pungent odor, the vapors when inhaled producing great irritation of the air passages. Its sp. gr. is 2.99. At—22°C., it solidifies to a reddish brown solid, and it boils at 63°C. Soluble in 28 parts of water, readily in alcohol. The

compounds of bromine closely resemble those of chlorine and iodine.

Uses.—Rarely in medicine as an external application and as an antiseptic. Bromine Water, the saturated, or three-per-cent solution, is used as a reagent.

Bromine must be preserved in small, tightly-fitting glass-stoppered bottles, usually kept in a tin box, and packed in plaster paris. Even with these precautions the whole contents of a vial have been known to escape, owing to its great volatility.

Two preparations of Bromine of indefinite composition are to some extent employed in medicine: Bromine Chloride, a liquid soluble in water; Iodine Bromide, a liquid soluble in 6 to 8 parts of water.

These are both used in very dilute solutions as application in infectious diseases.

IODINE—I.

Like chlorine and bromine, this element does not occur free in nature, and its compounds, though rather widely diffused, do not appear in great abundance. Its salts occur in the Ashes of marine plants, in certain marine animals, and in solution in small quantities in Sea-Water. It occurs also in combination with silver, lead, and in Saline Waters in combination with sodium, magnesium and potassium.

It is principally obtained from "kelp" or the ashes of seaweeds, by lixiviating them, concentrating the solution, and after the alkaline carbonates, sulphates and chlorides have been removed by crystallization, the iodine is obtained by distilling the mother liquor with Sulphuric Acid and Manganese Dioxide, the decomposition which takes place being represented by the following equation:

$$2NaI + 3H_2SO_4 + MnO_2 = I_2 + 2NaHSO_4 + MnSO_4 + 2H_2O$$

Sodium iodide.	Sulphuric acid.	Manganese dioxide.	Iodine.	Sodium sulphate (acid).	Manganese sulphate.	Water.

Iodine.—I—Iodum, U. S.—It should contain not less than 99 per cent of pure Iodine and be kept in glass-stoppered bottles in a cool place. Dark, lustrous, opaque crystals, belonging to the rhombic system. Sp. gr. 4.948. Practically insoluble in water, one in 5,000, but soluble in aqueous solutions of iodides of alkalies, etc.; soluble in 10 parts Alcohol. Fusing point between 113° and 115°C.; boiling point about 200°C., when beautiful violet vapors are given off. Iodine sublimes slowly at ordinary temperatures, and a crystal laid upon the skin imparts a characteristic brown color.

The following preparations of iodine are official:

Compound Solution of Iodine.—Liquor Iodi Compositus, U. S. —"Lugol's Solution."—A solution containing Iodine 5 Gm., Potassium Iodide 10 Gm., and Distilled Water to make 100 Gm. The Potassium Iodide dissolves the Iodine.

Iodine Ointment.—Unguentum Iodi, U. S.—A mixture of Iodine 4 Gm., Potassium Iodide 4 Gm., Glycerin 12 Gm., and Benzoinated Lard to make 100 Gm.

Tincture of Iodine.—Tinctura Iodi, U. S.—A solution of Iodine 7 Gm., Potassium Iodide 5 Gm., Alcohol to make 100 cc.

Amylum Iodatum.—A mixture of Starch 95 parts, Iodine 5 parts, Water to make 100 parts; was formerly official for testing purposes.

The following compounds with Organic radicals may also be mentioned:

Iodoform.—CHI_3.—Iodoformum, U. S.—Formed by the action of Iodine upon Alcohol, Ether and various compounds of the ether series, in the presence of one of the fixed Alkalies or Alkaline Carbonates.

Properties.—Small lemon-yellow, hexagonal crystals in the form of thin, lustrous scales. They are unctuous to the touch, with an odor resembling Saffron, and a peculiar sweetish and unpleasant iodine-like taste. But slightly soluble in water, soluble in 46.7 parts of alcohol, in 5.2 parts ether, soluble in chloroform and fixed and volatile oils and glycerin. Like iodine it volatilizes slowly at ordinary temperatures.

Off. Prep.—Unguentum Iodoformi; 10 per cent.

Uses.—Principally in the official ointment. Also in the form of powder as an external application. The odor may be partially masked by the addition of 4 per cent of thymol, menthol or coumarin. (See National Formulary).

Thymol Iodide.—$C_{20}H_{24}O_2I_2$.—Thymolis Iodidum, U. S.—Dithymol-diiodide obtained by condensation of Thymol and introduction of iodine into Thymol; contains 45 per cent Iodine.

A reddish-yellow bulky powder of aromatic odor, insoluble in water, slightly soluble in alcohol, readily soluble in ether fixed, and volatile oils.

Uses.—As a substitute for Iodine and Iodoform, externally as Dusting powder, in ointments, etc.

Iodol.—C_4I_4NH.—Iodolum, U. S.—Tetra iodo-pyrrol, a derivative of the base Pyrrol $(CH)_4NH$, obtained by direct action of Iodine upon the base in the presence of Alcohol.

A grayish crystalline powder, odorless and tasteless, practically insoluble in Water, soluble in 9 parts Alcohol, in 1.5 parts Ether, soluble in fixed oils and fats.

Uses.—Externally as a Dusting powder, in Ointments, etc.

SULPHUR—PHOSPHORUS—ARSENIC.

SULPHUR—S.

This is an abundant element in nature, occurring both free and in combination with various metals. Sulphur in a very pure form is found throughout the Rocky Mountain region, but the larger proportion of the sulphur used in medicines comes from the neighborhood of Mt. Ætna. It is usually more or less mixed with earth but is purified by fusion or sublimation.

Roll Sulphur or brimstone is prepared by pouring the melted sulphur into cylindrical moulds.

Sublimed Sulphur.—Sulphur Sublimatum, U. S.—Also called "Flowers of Sulphur," is obtained by volatilizing the sulphur and condensing it in a large chamber. It usually contains a small quantity of sulphuric acid, and sometimes also arsenous sulphide as impurities.

Sulphur is insoluble in water, slightly soluble in hot, absolute alcohol, ether, chloroform and benzol, depositing upon cooling in the form of crystals. It is soluble in hot aqueous solutions of the alkalies and alkaline earths, forming sulphides and very soluble in carbon disulphide.

Preparations of Sulphur.

Washed Sulphur.—Sulphur Lotum, U. S.—Prepared by washing sublimed sulphur thoroughly, first with water, containing 10 per cent Water of Ammonia, and then with Distilled Water to remove the above-named impurities.

Average Dose: 4 Gm. (60 grains).

Off. Prep.—Pulvis Glycyrrhizæ comp.

Sulphur Iodide.—Sulphuris Iodidum, U. S.—Prepared by fusing a mixture of one part of Sulphur and four parts of Iodine, in a flask, to a homogeneous mass.

Used exclusively in the form of 10 to 20 per cent ointment for Barber's Itch, etc.

Precipitated Sulphur.—Sulphur Præcipitatum, U. S.—Prepared by heating together freshly slaked Lime, Sublimed Sulphur and Water to make a solution of Calcium Sulphide, separated by filtration, then adding Hydrochloric Acid to precipitate the sulphur, collecting, thoroughly washing and drying the precipitate.

This article is found in commerce under the name of "Milk," or "Lac Sulphur," and consists largely of calcium sulphate, owing to the fact that sulphuric acid, instead of hydrochloric acid, is ignorantly employed to precipitate the sulphur.

Sulphur Ointment.—Unguentum Sulphuris, U. S.—15 Gm. Sulphur, Benzoinated Lard to make Gm. 100.

Uses of Sulphur.—Internally to purify the Blood; externally in the form of Ointment in skin affections. Lac Sulphur with Lead Acetate Solution used as a hair dye. Sulphur when burned in presence of water vapor is used to fumigate or disinfect infected articles, rooms, etc.

Sulphur Compounds.

These are very numerous, and many of them are of importance in pharmacy, but, as they are treated of elsewhere in these lectures, only the following will be mentioned here:

Hydrogen Sulphide.—H_2S.—Hydrosulphuric Acid.—A gas with a disagreeable odor as of decayed eggs, soluble in water, poisonous when respired in the concentrated form, and blackening paper which has been soaked in solution of lead acetate.

It precipitates many of the metals from solution as **sulphides**, and is therefore valuable as a reagent in pharmaceutical chemistry.

Hydrogen Sulphide or "Sulphureted hydrogen," as it is most frequently termed, is given off when some metals are dissolved in acids, as in the preparation of solutions of the chlorides of iron, zinc, etc., owing to the presence of Sulphur as an impurity.

PHOSPHORUS—P.

This element is not found free in nature, but certain of its compounds are rather abundant. It exists in the Bones of animals in the form of Calcium Phosphate, and these constitute its principal commercial source.

It is known in two Allotropic forms:

Phosphorus.—Phosphorus, U. S.—It should contain not less than 99.5 per cent of pure Phosphorus, and be carefully kept under water in strong, well-closed vessels, in a secure and moderately cool place, protected from light.

A transparent, nearly colorless or yellowish, highly refractive body that crystallizes in octahedrons, and at 15°C. has about the consistency of wax. Its sp. gr. is 1.83, it melts at 44°C. (111.2°F.); when heated in atmosphere free from oxygen, it boils at 290°C., yielding a colorless vapor.

It is almost insoluble in water, sparingly soluble in alcohol, more soluble in boiling absolute alcohol, slightly soluble in the volatile oils and ether, freely soluble in chloroform and carbon disulphide, and in about 50 parts of any fixed oil.

It is obtained by distilling a mixture of Calcium Metaphosphate and Charcoal heated to redness, when the Phosphorus is liberated, and escaping as vapor is collected under Water, condensed and, after redistillation to free it from impurities, is formed into cylindrical sticks.

Owing to slow oxidation, it is luminous in the dark, even at ordinary temperatures, but does not inflame until heated to slightly above its melt-

ing point. The compounds of phosphorous of pharmaceutical importance are elsewhere considered.

By exposure to the air it soon loses its transparency and becomes "corroded" or covered with a white coating, which is also true when kept under water, not entirely free from air.

Red or Amorphous Phosphorus is obtained by the action of heat and light on the ordinary form. The change takes place at a temperature between 240 and 250°C. If, however, red phosphorus be heated to a temperature of 260°C., it changes back to the ordinary form.

Red phosphorus has a reddish-brown color, and when in powder resembles pulverized iron oxide. In the massive form it has a conchoidal fracture, is much harder than ordinary phosphorus, undergoes no change either when exposed to the air, or when taken into the alimentary canal of an animal, hence is not poisonous if pure, and it does not take fire at any temperature below 240°C. The commercial product, used for the manufacture of matches, is usually more or less contaminated with ordinary phosphorus and is therefore poisonous.

Preparations of Phosphorus.

Pills of Phosphorus.—Pilulæ Phosphori, U. S.—Each pill containing 6-10 milligram or 1-100 grain of phosphorus, dissolved in Chloroform and made into a mass with Althea, Acacia and Glycerin, and coated with Tolu.

Official in the U. S. Ph., 1890, viith:

Oleum Phosphoratum, a one per cent solution of Phosphorus in Expressed Oil of Almonds, containing 10 per cent of Ether.

Spiritus Phosphori, a solution of ⅛ of one per cent of Phosphorus in absolute alcohol.

Elixir Phosphori, made from the Spirit, and contains 1 mg. (1-64 gr.) of Phosphorus in 4C.C. (1 fl. drm.).

Uses.—For internal administration Phosphorus should be largely diluted with an excipient or vehicle, as in the above preparations.

Undiluted it is a powerful irritant poison even in the smallest quantities; the **Antidote** being milk and prompt evacuation.

Average Dose: 0.0005 or 0.5 mg. (1-128 grain).

Phosphorus, owing to its inflammable character, must always be kept in a strong bottle and be well covered with water. In order to prevent accidents, which may occur by the accidental fracturing of the bottle, it should be placed in a stone jar in a safe location. The same precaution is necessary to observe in dispensing it, especially to guard against exposing it even for a short time without being covered with water, or mixed with some other substance serving to exclude the air.

ARSENIC—As.

Arsenic occurs in the free state in nature, but much more frequently in a state of combination. Such natural compounds are the sulphides, known as Orpiment and Realgar, arsenous oxide, and various minerals, in which it is found associated with metals. It is frequently present in iron pyrites and native Sulphur, and hence finds its way into sulphuric acid. It is also found in certain ferruginous deposits from Mineral Waters, nearly all of which, as well as sea-water, contain traces of arsenic.

Arsenic in the elementary form occurs in two modifications viz: **Amorphous** and **crystallized arsenic,** which differ also in specific gravity. Arsenic volatilizes at 180°C. without previously fusing. It does not change in a dry atmosphere, but when heated it burns with a bluish-colored flame, forming arsenic trioxide, and disseminating the peculiar alliaceous odor. Arsenic and nearly all its compounds are exceedingly poisonous. In its uncombined state it is chiefly used for the purpose of hardening lead in the manufacture of shot.

Arsenic and Its Compounds.

Arsine, or "Arsenetted Hydrogen."—AsH_3.—Is an extremely poisonous gas, having a very peculiar and characteristic smell. It burns with a pale-bluish flame, evolving dense white fumes of arsenic trioxide. On holding a cold piece of white porcelain in the flame, metallic arsenic is deposited as a brown or black shining mirror.

If the gas be passed through a hard-glass tube, which is heated by means of a glass flame placed beneath it, the arsenic is deposited near the heated portion of the tube, in the form of a bright, shining mirror. Upon this delicate reaction depends the application of **Marsh's test,** which is the one most frequently employed for the detection of small quantities of arsenic.

Arsenous Iodide.—AsI_3.—Arseni Iodidum, U. S.—It should contain 82.7 per cent of Iodine and 16.3 per cent of Metallic Arsenic. Made by direct combination of Arsenic and Iodine. It is soluble in 12 parts of water, 28 parts alcohol, completely soluble in Chloroform and Ether.

It is official in the form of the Iodides of Mercury and Arsenic Solution.

Arsenic Trioxide.—As_2O_3.—Arseni Trioxidum, U. S.—Formerly called "Arsenous Acid," also arsenic anhydride. When the oxide is dissolved in water, true Arsenous Acid, H_3AsO_3, is formed; hence, in the presence of moisture, arsenic oxide exhibits an acid reaction.

A heavy, solid, appearing as a white powder, known as commercial arsenic or "Rat's bane; as opaque crystalline masses resembling porcelain, or in amorphous, transparent pieces gradually, upon exposure, becoming opaque. It is the làtter which is used in pharmacy owing to its greater solubility, requiring 30 parts Water, while the crystalline kind requires about 100

parts Water, for solution. It is slowly but completely soluble in 15 parts of boiling water, and the solution on cooling deposits transparent, regular octahedral crystals: slightly soluble in alcohol, very soluble in glycerin, and freely soluble in hydrochloric acid and in solution of the alkalies and their carbonates.

Tests.—When thrown upon ignited charcoal the oxide is reduced, and emits an alliaceous odor. Its aqueous solution affords a lemon-yellow precipitate with a solution of ammonio-nitrate of silver, and a grass-green precipitate with ammonio-sulphate of copper. If the aqueous solution be acidulated with hydrochloric acid, and a stream of sulphureted hydrogen be passed through it, a bright yellow precipitate of arsenous sulphide will be produced. This precipitate is distinguished from the similar sulphides of antimony and tin by its insolubility in hydrochloric acid and by its solubility in test solution of ammonium carbonate.

The following methods are used for the detection of arsenic in medico-legal analyses: Marsh's test; the tests of Bettendorff and Gutzeit are more simple and are recognized in the U. S. Ph. (See Reagents, p. 521.)

Arsenous acid is a powerful irritant poison, and as it is the commonest form in which arsenic occurs in commerce, the majority of the cases of arsenical poisoning are produced by it.

The maximum safe dose for an adult is about 1-12 of a grain (0.006, or 6 mg.). The best antidote is Ferric Hydroxide with Magnesium Oxide, U. S.

Average Dose: 0.002 Gm.; 2 mg. 1-30 grain).

The following Solutions of Arsenic and its Compounds are official:

They are all of the uniform strength of one per cent, containing 10 Gm. in 1000 C.C.

Liquor Acidi Arsenosi; Solution of Arsenic Trioxide.
Liquor Arseni et Hydrargyri Iodidi; Donovan's Solution.
Liquor Potassii Arsenitis; Fowler's Solution.
Liquor Sodii Arsenatis; Solution of Sodium Arsenate.

BORON—CARBON—SILICON.

BORON—B.

Boron does not occur in the free state in nature, but is found combined with oxygen and hydrogen to form Boric Acid and also in the form of certain salts of this acid, the most important of which is Borax.

Boron is obtained in two Allotropic forms, one **crystalline,** the other **amorphous.**

The first form consists of monoclinic, octohedra or prisms, which have a luster and hardness exceeded only by the diamond. Their sp, gr. is 2.68.

The second form is a dark brown, tasteless and odorless powder, but slightly soluble in water, a very bad conductor of electricity, and fuses only at a very high temperature.

Neither of these is used in pharmacy. They are rather rare and expensive products of the chemical laboratory.

Compounds of Boron.

Boric Acid.—Acidum Boricum, U. S.—A tribasic acid having the formula H_3BO_3.

Transparent, shining, six-sided plates, which are somewhat unctuous to the touch, permanent in the air or a fine powder, odorless, bitterish, feebly acid, changing blue litmus paper to red, and turmeric paper to brown, the brown color of the latter not being altered in the presence of free hydrochloric acid. At 25°C. it is soluble in 18 parts of water, and at 100°C. in 3 parts: in 15.3 parts of alcohol and in 4.3 parts of boiling alcohol and in 4.6 parts glycerin.

Sources.—The principal commercial source of boric acid is the steam jets or fumaroles that issue from the earth in some districts in Tuscany. The acid that issues in these jets collects in the waters of the lagoons or lakelets formed near the orifices whence the jets issue, and is obtained in the crystalline form by evaporation. Borax is produced by treating the concentrated solution with Sodium Carbonate. Borax occurs also as a crystalline deposit in "Death Valley" in California, and is found in Nevada and South America.

Pharm. Uses.—Chiefly valuable for its anti-fermentative and anti-putrescent properties as an external application in the form of a **Saturated Solution** (5%) or as **powder** combined with an absorbent such as starch; or in the form of **ointment** prepared with petrolatum. In the preparation of ointments, the acid should be first triturated with a portion of the fused fat in a hot mortar before the whole of the fat is incorporated.

Average Dose: 0.5 Gm. (7½ grains).

PREPARATIONS.

Boro-glyceride prepared by heating 62 parts of Boric Acid with 92 parts of Glycerin to 150°C., until aqueous vapors cease to rise. As this congeals to a gelatinous mass, inconvenient to dispense it is chiefly used in 50-per-cent solution of glycerin.

Glycerite of Boroglycerini.—Glyceritum Boroglycerini, U. S.—A solution containing 50 per cent Glyceryl Boride or Boroglycerin in Glycerin.

CARBON—C.

This element exists in three modifications, **diamond, graphite** and **charcoal.** The two former are of but slight importance in pharmacy, but Charcoal, on account of the property it possesses of condensing large quantities of oxygen and other gases on the

surface of its particles, has important uses. By virtue of this property it absorbs the foul-smelling gases produced by the decay of organic matter and causes their oxidation, bleaches solutions containing organic coloring matter, etc.

Animal Charcoal.—Carbo Animalis, U. S.—This is prepared by burning the bones of Animals with a limited supply of Air.

It occurs in the granular form, which is best adapted to pharmacal uses, and as a dull black powder. When a portion of it is ignited in the open air, a white residue, called bone-ash, remains. This ash constitutes about 85% of the weight of the charcoal and should be almost completely soluble in hydrochloric acid with the aid of heat.

Purified Animal Charcoal.—Carbo Animalis Purificatus, U. S. —Consists of ordinary animal charcoal from which the Bone-Ash has been removed by boiling it with Hydrochloric Acid, leaving the nearly pure carbon residue.

Wood Charcoal.—Carbo Ligni, U. S.—This is prepared by burning Wood with a limited supply of Air, until all the volatile portions have been driven off or consumed.

For pharmaceutical purposes that prepared from **soft** wood or "willow" is preferred, its chief use being as an ingredient in Dentifrices and sometimes internally as an antacid.

Carbon Compounds.

These are very numerous and important. All **Organic compounds** come under this head. Of the organic compounds, Carbon Dioxide (carbonic acid) and Hydrocyanic Acid only will be treated here; the carbonates will be treated under their respective metals.

Carbon Disulphide.—CS_2.—Carbonei Disulphidum, U. S.—Commonly termed Carbon Bisulphide, a clear, colorless, strongly refractive, very volatile and inflammable liquid, having a strong, disagreeable odor and a sharp aromatic taste. It is almost insoluble in water, and its sp. gr. is 1.256. It is prepared by adding Sulphur to Charcoal heated to redness and condensing the vapor.

It has anæsthetic properties, but its principal pharmaceutical uses are as a solvent; caoutchouc, iodine, sulphur and some other substances, almost insoluble in ordinary solvents, being readily soluble in it.

Carbonic Acid.—Acidum Carbonicum.—This is a dibasic acid having the formula H_2CO_3. It is not stable at ordinary temperatures decomposing into H_2O and CO_2, hence it is mainly known through its compounds, the **carbonates.**

When Carbon Dioxide is forced into water, as in charging soda fountains, the water acquires a pleasant acid taste, and a slight acid reaction, which is doubtless due to the formation of carbonic acid by the union of the carbon dioxide with water. Carbonic acid is a feeble acid, being readily displaced from its combinations by the mineral and many of the organic acids. As the displaced acid escapes it is immediately decomposed, and the escaping gas, CO_2, produces effervescence. Frequently the chemical affinity between the carbonic acid and the base is so feeble in the carbonates that heat suffices for their decomposition. Calcium carbonate affords a familiar illustration.

Uses.—Although carbonic acid, save in the form of "**carbonated waters,**" has little use in pharmacy, many of the carbonates are of great importance. (These compounds are treated under the metals.)

Hydrocyanic Acid.—HCN.—Acidum Hydrocyanicum.—Carbon and Nitrogen unite to form the Compound radical **Cyanogen,** CN. With Hydrogen this forms an acid, Hydrocyanic Acid, HCN, which although containing Carbon and therefore an **Organic** Acid, may be treated here.

It occurs naturally in some vegetable structures, as in bitter almonds, cherry laurel, etc., but for the purposes of pharmacy it is obtained by distilling Potassium Ferrocyanide (prussiate) with Sulphuric Acid and Water (hence also the name prussic acid). It may also be readily obtained from the Silver Cyanide by agitating the salt with dilute Hydrochloric Acid. (See U. S. Ph.)

The pure anhydrous acid is a colorless, very mobile and volatile liquid, having the odor of bitter almonds. It is one of the most deadly of poisons, and when taken internally so small a dose as .05 of a grain has been known to produce death. Its soluble salts are also for the most part highly poisonous. All preparations of it must be handled, therefore, with the greatest care.

The diluted acid is the only kind used in medicine:

Diluted Hydrocyanic Acid.—Acidum Hydrocyanicum Dilutum, U. S.—Prussic Acid.—A liquid composed of 2 per cent by weight of absolute Acid, HCN, and 98 per cent of Water.

As the acid is highly volatile, the solution will rapidly deteriorate unless kept in small, dark, amber-colored, cork-stoppered vials in a cool place. It cannot even with these precautions be kept very long without deterioration, as the acid is slowly decomposed and it should therefore be replaced at least once yearly.

Average Dose: 0.1 c.c. (1½ minims).

SILICON—Si.

Silicon is never found in the free state in nature, although the most abundant of all the solid elements. It exists in combina-

tion with oxygen as silicon dioxide or silica, SiO_2, which is known in the crystalline condition as opal, flint, sand, etc. In the form of salts, it forms a large and important class of minerals termed silicates. In combination with oxygen, it is widely distributed in the vegetable kingdom, being found in the ashes of plants, and in the stems of cereals.

Sodium Silicate.—Na_2SiO_3 in the form of aqueous solution containing about 60 per cent of the salt; also known as "Soluble Glass." Sp. gr. 1.30 to 1.40 was formerly official as:

Liquor Sodii Silicatis.—Solution Sodium Silicate, used chiefly for surgical purposes, in the preparation of mechanical dressings and as a cement.

QUESTIONS ON LECTURE IV—SERIES 21.

Important.

Students will answer these questions on **letter size** paper, **in ink,** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all rules of the "Important Notice" must be complied with.

THE DIRECTOR.

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1. Give method of preparation for Aqua Distillata.
2. How should Aqua Distillata be preserved?
3. What **two** compounds of Hydrogen and Oxygen are official?
4. To what is the bleaching property of Hydrogen Dioxid due?
5. Enumerate the Haloid Acids, specifying those which are official.
6. By what other names is Hydrochloric Acid known?
7. What are the **characteristic** properties of Acids?
8. Give an example of a **solid,** a **liquid** and a **gaseous** acid.
9. Mention some **pharmacal** uses of Acids.
10. How does the U. S. Ph. direct that the Strength of Acids shall be ascertained?
11. How is "Aqua Regia" made, and **why** is it so called?
12. How is Nitric Acid prepared? Give "common name" for Nitric Acid.
13. Mention all the acids of P., specifying those which are official.
14. What is the difference between **Ortho** and **Meta Phosphoric Acids?**
15. Name the official **preparation** of Phosphorus, with **strength.**
16. How should Phosphorus be kept in the store?
17. In what **two** allotropic forms does Phosphorus exist?

18. **What is** the strength and **specific gravity** of Sulphuric Acid?

19. Mention the **preparations** of Sulphuric Acid with their **strengths.**

20. What is Oil of Vitriol? Elixir of Vitriol?

21. How do Metalloids **differ** from Metals?

22. Name three preparations of Chlorine with strengths.

23. How many Gm. of Liq. Chlori Comp. represent 0.5 of Cl?

24. What is the **proper** name for "Chloride of Lime?" What is Labarraque's Solution?

25. Mention an official Compound of I.

26. Name three official **preparations** of Iodine.

27. What is formed when Sulphur is **burned** in the presence of water vapor?

28. What **preparation** of S. is official?

29. Mention the official Solutions of Arsenic. What would be the Dose of each corresponding to **one-tenth** of a grain of Arsenic?

30. What gives the red color to Fowler's Solution and why is it used?

31. What is the official Antidote for Arsenical poisoning?

32. How would you prepare an Antidote for Arsenical poisoning, **extemporaneously?**

33. Into what official **preparation** does Boric Acid enter?

34. What is the **official** name of Prussic Acid? Its **strength** and **dose?**

35. What forms of Carbon are **official?**

36. Mention the official compound of B.

37. What is Marsh's test?

38. What is meant by the **basicity** of an acid?

THE ALKALI METALS.

The "Alkalies" or **Alkali Metals** comprise the elements Potassium, Sodium and Lithium, also the less important Rubidium and Cæsium.

These elements, although classed with the metals, lack the specific characteristics of metals, such as tenacity, malleability and ductility, being porous and easily divisible. On the other hand, their Oxides are strong **bases** forming **Salts** with the Acids, while the Oxides of the non-metals form **Acids** with Hydrogen.

They occur chiefly as Chlorides and Sulphates. By strongly heating the carbonates with Charcoal the **metals** are liberated in the form of **vapor** and condensed in a liquid free from Oxygen. Since they combine readily with oxygen they must be **protected from the air and water** and be kept submerged in **Benzin** or **Petroleum.**

They are called **light-metals** because of their low specific gravity, all being lighter than water.

Their compounds, with a few unimportant exceptions, are all **very soluble** in water, those of Sodium being more soluble than those of Potassium.

General Properties of the Alkalies.

By the term "Alkalies" is usually meant the hydrates or **hydroxides** of the alkali metals, Potassium and Sodium. These are also called "Caustic Alkalies," because of their properties. The carbonates are also called "alkaline carbonates," these possessing the alkali property in much less degree.

The Ammonium Compounds are also classed here with the Alkalies.

The alkalies have the following general character:

They combine with Acids to form **salts,** which may be of neutral, acid, or alkaline reaction, according to the proportion of the combined acid.

They affect vegetable colors, restore the **blue** color of Litmus, reddened by acids; change blue to green, and yellow to brown or a brownish color.

Their solutions are used to determine the strength of acids by neutralizing them in the presence of some organic coloring matter, termed an **indicator.** In the same way the acids are used to determine the strength of the alkalies, viz: The percentage of real alkali (KOH, for example) in the hydroxide. (See Volumetric Solutions, p. 544 and Indicators for Acidimetry and Alkalimetry, p. 541, U. S. Ph.)

The alkalies combine with the Acids of Fats and Oils and form compounds called **soaps.** This is the process of **saponification.**

They form soluble compounds with all fatty and **resinous** substances, hence their **great** value for **cleaning** purposes. They destroy the most common form of **Bacteria**, and with boiling water are, therefore, the most effective agents to clean and purify clothing in the process of **laundrying**.

The New Pharmacopœia—U. S. Ph. VIIIth (1900) defines the strength of chemicals by designating the **percentage amounts** of the **pure substance** the particular article should contain.

Since this is not of great interest to students such strengths are given here only when of especial importance.

AMMONIUM AND ITS COMPOUNDS.

The combination of Nitrogen and Hydrogen, known as **Ammonium**, NH_4, is not found free and has never been isolated.

The compound known as **Ammonia Gas**, NH_3, occurs in the atmosphere, in natural waters and in the Earth.

Its chief source is a product of the destructive distillation of wood and **coal**, and from the latter all its compounds are directly obtained.

Its compounds are frequently classed with the **alkalies**, and its general characters are the same, except in one important particular, namely: All Ammonium compounds are **volatile** at a moderate temperature.

Salts of Ammonium evolve ammonia **gas** when heated with alkali hydroxides, the gas forms white vapors with Hydrochloric Acid, condensable into Ammonium Chloride, and, similarly to the Alkalies, it **saponifies** fats and **restores** vegetable blues that have been reddened by Acids.

Ammonia and Its Preparations.

Ammonia—NH_3.—The gas may readily be obtained by heating any Ammonium salt with an alkali, such as Soda or Potash, or an alkaline earth, such as Lime. The following equation indicates the reaction:

$$2NH_4Cl + Ca(OH)_2 = 2NH_3 + CaCl_2 + 2H_2O.$$

Ammonium Chloride.—"Sal Ammoniac" (muriate of ammonia) being cheap, is the salt usually employed for the purpose, and in order to insure the complete decomposition of the salt an excess of lime is used.

Ammonia is a colorless gas, with a pungent odor, strong alkaline reaction, and a sp. gr. (taking air as the standard) of 0.586. It neutralizes and forms stable compounds with the acids. All Ammonium compounds are completely volatilized by heat.

By cold and pressure it may be reduced to the liquid condition, when it forms a colorless, highly refractive, mobile liquid which boils at—33.7°C., and at —75°C. becomes converted into a crystalline solid. Liquid ammonia is quite extensively used as a substitute for, and in the manufacture of, ice.

It is highly soluble in water, this liquid taking up, at 0°C. and under the normal atmospheric pressure, more than 1,100 volumes of the gas. The gas is probably not merely dissolved, but a portion enters into combination with water, forming NH_4HO, or Ammonium Hydrate. This compound has, however, never been isolated.

Water of Ammonia—Aqua Ammoniæ, U. S.—An aqueous solution containing 10 per cent by weight of the gas, NH_3. Is a colorless, transparent liquid of a very pungent odor, and a strongly acrid alkaline taste and alkaline reaction. Its sp. gr. at 25°C. is 0.958.

Official Preparations.—Linimentum Ammoniæ; Spiritus Ammoniæ Aromaticus.

The strength of the weaker Ammonia Water of commerce is usually designated by one or more F.'s, an arbitrary standard. The number of F.'s attached to a label usually does not indicate the percentage strength of the ammonia water contained in it. Although the mark of 4 F. is supposed to mean stronger water of ammonia, or 28 per cent, it usually indicates about 18 per cent. Pharmacists should insist that Ammonia Water be designated by its **percentage strength** only, when purchasing.

Stronger Water of Ammonia—Aqua Ammoniæ Fortior, U. S. —An aqueous solution containing 28 per cent by weight of the gas. Its sp. gr. is 0.897. It should be kept in a cool place, in tightly-stoppered bottles which are not quite filled, and care should be exercised in opening the bottles. (For tests see U. S. Ph.)

Official Preparation.—Spiritus Ammoniæ.

Uses.—As a precipitant in the preparation of many hydrates and salts, held in solution by acids, for example, ferric hydrate, calcium phosphate, and most of the alkaloids. As a solvent in the extraction of some drugs, and for neutralizing acid solutions. Combined with citric acid it forms **double salts** with some of the metals, as for example, bismuth and iron, rendering these soluble. It is also used as a general solvent for "**grease,**" and in the preparation of many pharmaceutical products.

Ammonium Compounds.

Ammonia gas is a by-product of gas-works, being found in the so-called gas-liquor. By heating this liquor with Lime, in a retort, the gas is evolved and may be at once conducted into water to form Ammonia Water, or into aqueous solution of an Acid. If Sulphuric Acid be used Ammonium Sulphate is formed; if Hydrochloric Acid, the Chloride of Ammonium or "Sal Ammoniac" is obtained by crystallization. From either

of these compounds all the other Ammonium Compounds are produced.

Ammonium Sulphate—$(NH_4)_2SO_4$—Ammonii Sulphas.—Colorless, transparent, rhombic prisms, permanent in air, odorless, possessing a sharp saline taste, and neutral reaction. Soluble in 1.3 parts of water, insoluble in absolute alcohol. It is not official.

Ammonium Chloride—NH_4Cl—Ammonii Chloridum, U. S.—It should contain not less than 99.5 per cent of pure Ammonium Chloride. A white crystalline powder, with a cooling, saline taste, without odor, a slightly acid reaction, permanent in the air, and on heating with caustic potassa or lime, evolving ammonia gas. Soluble in 2 parts of water, in 50 parts of alcohol and in 5 parts of glycerin.

Preparation.—Muriate of Ammonia, in the crude state, occurs in tough, fibrous, crystalline masses. The pure or granulated form, the kind official, is prepared from the crude Sal Ammoniac by dissolving it in about twice its weight of hot water, adding a little chlorine water to convert any ferrous chloride present into a ferric salt, then ammonia in excess, which precipitates the iron present in the form of ferric hydrate. The liquid is then filtered, and the clear filtrate evaporated until a pellicle forms, when it is allowed to cool and crystallize; or it may be evaporated nearly to dryness in a shallow vessel, and the **granular**, crystalline powder dried between sheets of filter paper. Its preparation is well adapted to the beginner as the first chemical to be made in the pharmacy.

Dose: 0.5 Gm. (7½ grains).

Official Preparation.—Trochisci Ammonii Chloridi.

Ammonium Carbonate—$C_2H_{11}N_3O_5$—Ammonii Carbonas, U. S.—It should contain not less than 97 per cent of a mixture of acid ammononium carbonate [$CO(OH)ONH_4$] and ammonium carbamate [$CO(NH_2)ONH_4$] and should yield not less than 31.58 per cent ammonia gas. Only translucent pieces should be used, which should be kept in well-stoppered containers.

Slowly but completely soluble in 4 parts of water, decomposed by hot water, alcohol dissolves the carbamate and leaves the acid carbonate.

White, translucent masses, with odor of ammonia, and giving out both ammonia and carbon dioxide on exposure to the air. Taste saline, reaction alkaline.

Made by heating a mixture of Chalk and Ammonium Chloride. The Ammonium Carbonate sublimes and is collected in the cooler parts of the vessel, or in a receiver.

Uses.—As "**Hartshorn,**" an ingredient in "smelling salts" and in the two official preparations. In conjunction with Syrups of **Acid** reaction, such as Squill and Glycyrrhiza for cough syrups, the ammonium carbonate reacting with the acids should be gradually dissolved in a mortar, with the

addition of water when permissible, so as to prevent frothing. Was also used for leavening bread or pastry, as it completely volatilizes by the heat on baking and the gases make the dough porous.

Dose: 0.25 Gm. (4 grains).

Official Preparations.—Liquor Ammonii Acetatis; Spiritus Ammoniæ Aromaticus.

Ammonium Acetate—$(NH_4)C_2H_3O_2$.—A solution made by saturating dilute Acetic Acid with Ammonium Carbonate, constitutes Liquor Ammonii Acetatis, U. S., or Spirit of Mendererus.

This preparation should always be prepared extemporaneously, since when fresh it is a most refreshing draught to feverish patients, while it rapidly loses its carbonic acid, and then possesses a disagreeable saline, frequently decidedly alkaline, taste. The pure acid (U. S. Ph., not the commercial so-called No. 8) should be used, properly diluted, and the ammonium carbonate, in translucent pieces, gradually added with constant stirring, until only a slight effervescence takes place. The solution is then poured in a vial, which must be well corked so as to preserve the carbonic acid. When administered, the preparation, owing to its sparkling character and pleasant acidity, forms a cooling and most agreeable potion.

Dose: 16 cc. (4 fl. drams).

Official Preparation.—Liquor Ferri et Ammonii Acetatis. Dose, 16 cc. (4 fl. drams).

The following are all made by saturating their respective Acids with Ammonia Water and obtaining the Salt by crystallization.

They may be made extemporaneously (as wanted) and kept in solution. By referring to the Saturation Tables, pp. 622-624, of the U. S. Ph., the respective quantities of Acids and Alkalies required to produce 100 parts of the Salt may be seen at a glance.

Ammonium Benzoate—$(NH_4)C_7H_5O_2$—Ammonii Benzoas, U. S.—Should contain not less than 98 per cent of pure Ammonium Benzoate [$C_6H_5.COONH_4$]. As it loses ammonia upon exposure to air it should be kept in well-stoppered vials.

A white crystalline salt having a slight odor of Benzoic Acid, and a saline, bitter and highly acrid taste, made by saturating Benzoic Acid with Ammonia Water and evaporating, keeping the ammonia in excess until crystals begin to form. Soluble in 10 parts of water and 25 parts of alcohol.

Dose: 1 Gm. (15 grains).

Ammonium Bromide—NH_4Br—Ammonii Bromidum, U. S.—Should contain not less than 97 per cent Ammonium Bromide.

A transparent crystalline or white granular salt, changing to yellowish on exposure to moist air, and having a pungent saline taste. Soluble in 1.2 parts of water, in 12.5 parts alcohol.

Prepared by agitating Iron wire with a solution of Bromine until the

odor of bromine can no longer be perceived, thus forming Ferrous Bromide, adding Ammonia Water to excess, filtering and evaporating to dryness.

Uses.—Mostly in the form of **Elixir** containing 10 grains to the fluid dram.

Dose: 1 Gm. (15 grains).

Ammonium Citrate.—Made by saturating a solution of Citric Acid with Water of Ammonia so as to be of a faint alkaline reaction, recognized by a slight odor of ammonia.

Uses.—As a solvent for many salts, especially in **Elixirs**; with Iron and Bismuth it forms soluble double compounds, viz: Ammonio-citrate of Iron and Ammonio-citrate of Bismuth. These will be treated under their respective metals.

Ammonium Iodide—NH_4I—Ammonii Iodidum, U. S.—Should contain not less than 97 per cent pure Ammonium Iodide.

A white, granular, deliquescent salt, changing to yellow or yellowish-brown on exposure to the air, and it should therefore be kept in bottles of amber glass. Odorless when white but with a faint odor of iodine when colored by exposure; a sharp saline taste, and a neutral reaction.

Prepared by saturating Ammonia Water with Hydriodic Acid. Soluble in 0.6 parts water, in 9 parts alcohol.

Uses.—A spirit, prepared by mixing an alcoholic solution of iodine with strong ammonia water in such proportion as to yield a **colorless** product, consisting of ammonium iodide and ethyl iodide. This has been erroneously termed "decolorized tincture of iodine." [See National Formulary.]

Ammonium Valerate—$NH_4C_5H_9O_2$—Ammonii Valeras, U. S.—Should contain not less than 98 per cent of pure Ammonium Valerate [$C_4H_8COONH_4$].

White or colorless, tabular crystals, deliquescent in moist air, possessing the peculiar odor of valerianic acid, a sharp, sweetish taste and a neutral reaction. Freely soluble in both water and alcohol.

Made by passing dry Ammonia Gas into Valerianic Acid when the salt crystallizes out. On a large scale it is prepared from Fusel Oil (amylic alcohol), which bears the same relation to valerianic acid as ordinary alcohol bears to acetic acid, and like the last named alcohol is converted into its respective acid by oxidation.

Uses.—Principally in the form of **Elixirs** containing two grains to the fluid dram. Solutions of the salt must be carefully neutralized with ammonia so as to prevent the volatilization of the acid, to which the disagreeable odor is due. [See National Formulary.]

Dose: 0.5 Gm. (7½ grains).

Ammonium Salicylate—$NH_4C_7H_5O_3$—Ammonii Salicylas, U. S.—Should contain not less than 98 per cent of pure Ammonium Salicylate [$C_6H_4(OH)COONH_4$].

A white crystalline powder, or lustrous prisms, without odor, taste first slightly saline then bitter and finally sweetish. Soluble in 0.9 parts water, in 2.3 parts alcohol. Made by saturating Ammonia Water with Salicylic Acid and evaporating the solution.

Uses.—Internally in Rheumatism.

Dose: 0.25 Gm. (4 grains).

Unofficial Compounds.

Ammonium Nitrate—NH_4NO_3—Ammonii Nitras.—Colorless, usually rhombic prismatic crystals, somewhat deliquescent, odorless, with a sharp bitter taste and neutral reaction. Soluble in half its weight of water and in 20 parts of alcohol. Completely resolved by heat into **nitrous oxide** (laughing gas) and water. Made by saturating dilute Nitric Acid with Ammonia Water or with Ammonium Carbonate.

Uses.—In dentistry for the production of "Laughing Gas."

Ammonium Oxalate.—Made by saturating a solution of Oxalic Acid with Ammonia, and crystallizing. It is of importance in pharmaceutical chemistry as a **test** for calcium, and the Test Solution is official.

Ammonium Phosphate — $(NH_4)_2HPO_4$ — Ammonii Phosphas. — Colorless, translucent, prismatic crystals, evolving ammonia on exposure to air, odorless, possessing a cooling saline taste, and neutral or slightly alkaline reaction. Made by adding an excess of Ammonia Water to dilute Phosphoric Acid, and evaporating slowly until crystals form.

Ammonium Sulphide.—A solution made by saturating Ammonia Water with Hydrogen Sulphide. It is of importance in pharmaceutical chemistry as a **test**, and the solution is official.

POTASSIUM.

Although potassium does not occur free in nature, it is a widely distributed and rather abundant metal. It occurs in many silicates, as Feldspar, Leucite, etc.; as Chloride in certain localities, as at Stassfurt, Germany, and also in solution in small proportion in Sea-Water, and in the waters of certain mineral springs; in the form of Nitrate in various soils, and in other combinations in most soils; and in the tissues of plants.

Potassium—K—From Kalium, the older name for the element. Potassium is developed from the Anglo-Saxon Potash, the residue in a pot in which a solution of wood-ash had been evaporated.

It is obtained in the metallic form by heating to a white heat a mixture of Charcoal and Potassium Carbonate, and rapidly cooling the vapor of potassium as it escapes from the crucible, by conducting it into a properly constructed receiver without access of air.

The following equation represents the reaction which takes place:

$$K_2CO_3+2C=K_2+3CO.$$

It may also be prepared on a small scale by the electrolysis of Potassium Cyanide.

Properties.—A silvery white metal, sp. gr. 0.875, brittle, and possessing a

crystalline fracture at 0°C., but of a waxy consistency, and easily cut at 15°C., melting at 62.5°C., oxidizes readily on exposure to damp air, and forms the hydroxide with such rapidity when thrown upon water, that the hydrogen set free from the latter is inflamed, and is colored a characteristic violet by the volatilized potassium oxide, which is produced. It must be **preserved under Benzin** or some other liquid that does not contain oxygen.

Uses.—Being a powerful reducing agent, it has some important uses in the chemical laboratory, but has no pharmaceutical importance. Its compounds, however, are of great importance.

Natural Potassium Compounds.

The **natural** Potassium Compounds are the Chloride, Sulphate, Nitrate and Bitartrate.

Potassium Sulphate—K_2SO_4—Potassii Sulphas, U. S.—Occurs native in Sea-Water; in certain mineral waters, mixed with Common Salt, in some salt beds, and is obtained as a by-product in certain manufactures.

In colorless, transparent, six-sided rhombic crystals. It does not change on exposure to the air, has a cooling, saline taste, and is neutral to test paper. Soluble in 4 parts of water and nearly insoluble in alcohol.

Uses.—In medicine, rarely, as a purgative. Owing to the hardness of the crystal, this salt was formerly used in the preparation of **Dover's Powder** for the purpose of facilitating comminution of the active ingredients; it was replaced by sugar of milk in the U. S. Ph., '80.

Potassium Sulphite—$K_2SO_3+3H_2O$—Potassii Sulphis.—Made by passing a current of Sulphurous Acid gas into a solution of Potassium Carbonate. Not official.

In oblique rhombic octahedral crystals. Odor slight, taste bitter, saline and sulphurous, deliquescent, freely soluble in water, but slightly soluble in alcohol. On heating, decomposition takes place, water and sulphurous acid being given off.

Uses.—In medicine as an anti-fermentative and anti-putrefactive.

Potassium Nitrate—KNO_3—Potassii Nitras, U. S.—Commonly called Saltpetre. Usually obtained as a product of fermentation that takes place in soils, rich in certain forms of organic matter. It is common in certain hot countries, as India, Egypt, Persia, some portions of South America, etc., where it occurs as an **efflorescence** in the soil. This is collected and purified by repeated solution and recrystallization.

Six-sided, usually striated, rhombic prisms, that are colorless, odorless, with a cooling saline taste, containing water enclosed mechanically in the interstices; or a crystalline powder. It is soluble in 3.8 parts water, in 0.4 boiling water and sparingly in alcohol. At a high temperature saltpetre evolves oxygen and is gradually changed to the nitrite.

Uses.—As a diluent in fused Silver Nitrate, as an ingredient in medicated **vapors** for asthma, etc., as a **diuretic**, and in large doses as a cardiac and

nervous sedative. In the arts for **Gunpowder**, and in domestic practice for **curing meat**.

Dose: 0.5 Gm. (7½ grains).

Charta Potassii Nitratis, made by saturating paper in a solution of the salt and drying it was formerly official.

Potassium Bitartrate—$KHC_4H_4O_6$—Potassii Bitartras, U. S.—Cream of Tartar. Prepared from **Argols**, or argol, a crystalline deposit formed in grape-juice during the vinous fermentation. It consists of Cream of Tartar associated with Calcium Tartrate and other impurities. The crude product is boiled with water, through which the impurities are largely removed, and then purified by repeated crystallization.

Colorless or nearly colorless rhombic crystals, or a white, gritty powder, odorless, pleasantly acid to the taste, and having an acid reaction. It is soluble in 200 parts of water, in 16 parts boiling water, nearly insoluble in alcohol. It blackens when strongly heated, and gives out the odor of burnt sugar.

As the salt is very liable to adulteration, the pharmacopœial tests for purity should always be applied to samples purchased for medicinal use.

Uses.—As the source of **Tartaric Acid**, and in the preparation of Antimony and Potassium Tartrate, Iron and Potassium Tartrate, Sodium and Potassium Tartrate, and Potassium Tartrate.

In medicine as a laxative, refrigerant, and diuretic. Mixed with some dry powder, such as starch, in conjunction with Sodium Bicarbonate, it is largely used as **baking powder**. The carbonic acid, by exposure to moisture and heat, is liberated in the process of baking, thus rendering the bread light and porous.

Dose: 2 Gm. (30 grains).

Official Preparation.—Pulvis Jalapæ Compositus, and as an ingredient in many unofficial mixtures. Popularly as a **blood purifier** mixed with **flowers of sulphur**.

From Potassium Bitartrate the following are made:

Potassium and Sodium Tartrate—$KNaC_4H_4O_6+4H_2O$—Potassii et Sodii Tartras, U. S.—This is commonly called Rochelle Salt, and is prepared by saturating a solution of Sodium Carbonate with Potassium Bitartrate, evaporating the solution and crystallizing.

In the form of a white powder, or in transparent rhombic crystals, slightly efflorescent in dry air, odorless, and with a bitterish mildly saline taste. Soluble in 1.2 parts of water and nearly insoluble in alcohol. Melts in its water of crystallization at about 75°C.; at a more elevated temperature it dries and then chars.

Uses.—In medicine as a **laxative**.

Dose: 8 Gm. (120 grains).

Official Preparation.—Pulvis Effervescens Compositus.

Potassium Tartrate—$(K_2C_4H_4O_6)_2+H_2O$—Potassii Tartras.—

Made by neutralizing a solution of Cream of Tartar with Potassium Carbonate. Not official.

Monoclinic, transparent, somewhat deliquescent crystals, with a saline, somewhat bitter taste, and neutral to test paper. When heated, water is given off, and at a higher temperature the mass becomes charred. Very soluble in water.

Uses.—In medicine chiefly as an aperient, and in pharmacy as a **test for glucose** in Fehling's solution.

Potassium Carbonate and Other Compounds.

From Potassium Sulphate the Carbonate is made, and from this in turn all the other Potassium compounds.

Potassium Carbonate—K_2CO_3—Potassii Carbonas, U. S.—Salts of Tartar. Obtained by leaching Wood-Ashes and evaporating the lye thus obtained and purifying it; also from Potassium Sulphate which occurs in sea-water, and as mineral in some localities.

White granular powder, or in white solid masses, odorless, with a somewhat caustic and alkaline taste, and alkaline reaction. It is highly deliquescent, and must be kept in well-stoppered bottles. Soluble in 0.91 part of water, insoluble in alcohol.

Uses.—For the general purposes of an **alkali**, in Sulphureted Potassa and many unofficial preparations. In medicine it is used externally on account of its irritant or caustic effect, and internally as an antacid and diuretic. In large doses an irritant caustic, the proper antidote being dilute acids, such as vinegar.

Dose: 1 Gm. (15 grains).

Potassium Bicarbonate—$KHCO_3$—Potassii Bicarbonas, U. S.—By saturating a solution of the carbonate with Carbon-Dioxide, filtering, evaporating, and allowing the salt to crystallize.

Transparent, colorless, monoclinic prisms, permanent in dry air, without odor, taste saline and somewhat alkaline. Soluble in 3 parts water, in 2 parts at 50°C.; in solutions above this temperature, Carbon Dioxide is given off. Almost insoluble in alcohol. Heated to about 200°C., it gives off water and carbon dioxide, and is converted into the carbonate. An impure variety, in the form of a white powder, was formerly sold under the name of **Saleratus.**

Uses.—In many saline draughts, when of acid reaction, to furnish **Carbonic Acid** by decomposition. For that purpose it is used in the official Solution of Magnesium Citrate.

Dose: 2 Gm. (30 grains).

Potassium Hydroxide—KOH—Potassii Hydroxidum, U. S.—Potassa (U. S. 1890), "Caustic Potash." Should contain not less than 85 per cent of pure Anhydrous Potassium Hydroxide and not more than 2 per cent of other inorganic substances, except water. It should be kept in well-stoppered bottles of hard glass.

Usually obtained by decomposing a solution of Potassium Carbonate by means of freshly slaked Lime. It is commonly sold in sticks or pencils, which are hard, white, very deliquescent, very caustic to the taste, and strongly alkaline in their reaction. Soluble in one-half its weight of water, and in twice its weight of alcohol.

Liquor Potassæ.—Potassa 56 parts, and Distilled Water, 944 parts.

Potassa cum Calce, made by rubbing together equal parts by weight of Potassa and Lime, formerly official. "Potassa by alcohol," a pure unofficial form, is prepared by precipitating the impurities from a solution of the commercial Potassa with Alcohol.

Sulphurated Potassa—Potassa Sulphurata.—"Liver of Sulphur." Formerly official. Not a definite compound, but a mixture of several, produced by gradually heating a mixture of Sublimed Sulphur, 1 part, and Potassium Carbonate, 2 parts, until effervescence ceases, and cooling the fused mass by pouring it out on a marble slab.

It is, when fresh, composed chiefly of potassium trisulphide and potassium hyposulphite, but usually contains also a small percentage of unchanged potassium carbonate. It rapidly undergoes change, on exposure to the air, and must be kept in tight-fitting, glass-stoppered bottles.

Liver-colored masses, changing to greenish yellow or brownish-yellow on exposure; odor faint, disagreeable, resembling sulphureted hydrogen; taste bitter, alkaline and repulsive.

Uses.—In the preparation of Lotions, Ointments, etc., for diseases of the skin or mucous surfaces. Seldom used internally.

Compounds of Potassium.

Potassium Chlorate—$KClO_3$—Potassii Chloras, U. S.—Usually obtained by the action of Chlorine on a solution of Caustic Potash, or on a moistened mixture of Potassium Carbonate and Caustic Lime. After saturation with Chlorine the mixture is diluted with Water and then evaporated until crystals begin to form.

Colorless monoclinic prisms or plates, possessing a pearly lustre, neutral to test paper, odorless, and with a cooling, saline taste. Soluble in 16 parts of water, in 1.7 parts of boiling water, very sparingly soluble in alcohol at any temperature. When heated the salt first fuses, then gives off its **oxygen**, leaving a residue of potassium chloride.

Uses.—As a source of oxygen; in the manufacture of Potassium Permanganate, and in medicine chiefly as a remedy for ulcers in the mouth and throat.

Dose: 0.25 Gm. (4 grains).

Official Preparations.—Trochisci Potassii Chloratis; and an unofficial solution containing 2 Gm. (30 grains) of the salt in 32 cc. (fluid ounce) for dispensing purposes.

Caution: Potassium chlorate should be kept in glass-stoppered bottles, and **great caution should be observed** in handling the salt, as dangerous **explosions** are liable to occur when it is mixed with organic matter (cork, tannic acid, sugar, etc.) or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances, and either heated directly, or subjected to **trituration** or concussion.

Potassium Bromide—KBr—Potassii Bromidum, U. S.—Obtained by the reaction of Potassium Carbonate upon a solution of Ferrous Bromide, according to the following equation:

$$FeBr_2+K_2CO_3=2KBr+FeCO_3.$$

Colorless, cubical crystals, permanent in dry air, odorless, with a saline taste, and neutral reaction. Soluble in 1.5 parts of water, in less than its weight of boiling water, and in 200 parts of alcohol. At a dull red heat it fuses, without loss of weight.

Uses.—As a sedative, anæsthetic, and hypnotic. In various unofficial preparations: **Elixir**, containing 10 grains to the fluid dram, and in a **Compound Mixture of Potassium Bromide and Chloral**, containing 15 grains of each in one fluid dram, and ⅛ grain each extract Cannabis Indica and extract Hyoscyamus. [See National Formulary.]

Dose: 1 Gm. (15 grains).

Potassium Iodide—KI—Potassii Iodidum, U. S.—Obtained by heating Iodine in a solution of Potassa, concentrating by evaporating and treating with charcoal, drying and heating to redness, dissolving in Distilled Water, and crystallizing. The reactions that take place are represented as follows:

$$(1)\quad 6KOH+3I_2=5KI+KIO_3+3H_2O.$$

Potassium Iodate, KIO_3, is poisonous, and is heated with charcoal, when it becomes reduced to iodide:

$$(2)\quad 2KIO_3+3C_2=2KI+6CO.$$

Colorless, transparent or translucent, cubical crystals, somewhat deliquescent, with a faint, peculiar odor, a saline taste, and neutral reaction. Soluble in 0.7 part of water, in one-half its weight of boiling water, and in 12 parts of alcohol.

Dose: 0.5 Gm. (7½ grains).

Uses.—As a reagent in the laboratory, and in medicine as a resolvent, being the most valuable of all the compounds of iodine. It is usually administered in Compound Syrup of Sarsaparilla, more especially to mask its disagreeable taste. It is also used to **make iodine soluble** in water or watery mixtures, as in the following official preparations:

Liquor Iodi Compositus: Iodine, 5; Potassium Iodide, 10; Water, to 100 Gm.

Unguentum Iodi: Iodine, 4; Potassium Iodide, 4; Glycerin, 12; Benzoinated Lard, to 100 Gm.

Tincture Iodi: Iodine, 7 Gm.; Potassium Iodide, 5 Gm.; Alcohol, to 100 cc.

Official Preparations.—Unguentum Potassii Iodidi: Potassium

Iodide, 10 parts; Potassium Carbonate, 0.6 part; boiling Water, 10 parts; Benz. Lard, to 100 parts.

Potassium Hypophosphite—KPH_2O_2—Potassii Hypophosphis, U. S.—Obtained by boiling a solution of Potassa with Phosphorus.

Granular powder or white confused crystalline masses, neutral to test paper, odorless, with a sharp saline taste, very deliquescent, soluble in 0.5 parts of water, and in 7.3 parts of alcohol.

Uses.—In the preparation of **Syrup of Hypophosphites** and various unofficial preparations, **Elixirs** and **Cod-Liver Oil Emulsions.**

Dose: 0.5 Gm. (7½ grains).

Potassium Arsenite, solution—Liquor Potassii Arsenitis, U. S. —Fowler's Solution.

Made by boiling 1 Gm. of Arsenic Trioxide and 2 Gm. Potassium Bicarbonate in 10 cc. of Water until solution is complete, and then adding Compound Tincture of Lavender, 3 cc., and Water enough to measure 100 cc.

Potassium Bichromate—$K_2Cr_2O_7$—Potassii Bichromas, U. S.—Obtained from Chrome-ironstone, $FeOCr_2O_3$, by roasting it, heating it strongly with Potassium Carbonate and Lime, leaching out the Potassium Chromate thus formed, and converting it into the Bichromate by treating the solution with Sulphuric Acid.

Garnet-red tables or prisms, odorless, with an unpleasant, bitter, metallic taste, and an acid reaction. Soluble in 9 parts of water, insoluble in alcohol, fusible below red heat into a transparent, red liquid, and decomposes at a white heat into oxygen, normal chromate, and chromic oxide.

Uses.—As a test in pharmaceutical chemistry (see the official Test Liquid), in the preparation of Chromic and Valerianic Acids. Also in dyeing, and with Sulphuric Acid for coloring liquids in "**show bottles.**" Internally in large doses it is **poisonous,** chalk, magnesia or soap being the proper antidotes.

Dose: 0.01 Gm. (1-5 grain).

Normal Potassium Chromate, or yellow chromate of potash, K_2CrO_4. Occurs in six-sided, lemon-yellow crystals, and is prepared by adding Potassium Carbonate to a solution of the Bichromate so long as effervescence is produced.

Uses.—Chiefly for the preparation of **test solution.**

Potassium Permanganate—$KMnO_4$—Potassii Permanganas, U. S.—Usually obtained by the reaction of Potassa and Potassium Chlorate on Manganese Dioxide.

Dark purple, or nearly black, rhombic prisms, with a metallic luster, neutral to test paper; permanent in the air, odorless, sweetish and afterward disagreeable to the taste. Soluble in 15 parts of water, forming a deep purple colored solution in 3 parts boiling water. In contact with **Alcohol** or **Glycerin** is it decomposed with explosive force.

Uses.—Owing to the fact that it readily parts with oxygen in contact with

organic matters, it is used as a **Disinfectant**, in the preparation of washes for foul ulcers, etc., and is also given internally in diphtheria, sore throat, etc. It should be exhibited only with substances free from organic matter, lest it be reduced, and for this reason, when prescribed in the pill form, the excipient should be petrolatum and kaolin or similar **non-oxidizable** substances.

Dose: 0.065 Gm. (1 grain).

Caution.—Potassium Permanganate should be kept in glass-stoppered bottles protected from light and should not be brought in contact with organic or readily oxidizable substances. Mixed with glycerin it may cause explosion.

Organic Compounds of Potassium.

The following are compounds of organic radicals:

Potassium Acetate—$KC_2H_3O_2$—Potassii Acetas, U. S.—Made by saturating a solution of Potassium Carbonate with Acetic Acid, and evaporating the solution until crystals are formed.

A deliquescent, crystalline or granular white salt, without odor, and having a mildly pungent and saline taste. Soluble in 0.4 part of water and 2 parts of alcohol, melts to an oily liquid at a temperature of about 290°C., and at a higher temperature is decomposed, evolving acetic acid, acetone and other volatile products, and leaves potassium carbonate and charcoal. It must be kept in well-stoppered bottles.

Uses.—In medicine as a diuretic and diaphoretic.

Dose: 2 Gm. (30 grains).

Potassium Citrate—$K_3C_6H_5O_7+H_2O$—Potassii Citras, U. S.—Obtained by neutralization of a solution of Citric Acid with Potassium Bicarbonate, evaporation and granulation.

A white, deliquescent powder or transparent prismatic crystals with cooling, faintly alkaline taste and neutral or slightly alkaline reaction. Soluble in 0.5 part of water, sparingly soluble in alcohol, loses its water of crystallization at 200°C., and chars.

Uses.—As an arterial sedative and a diaphoretic.

Dose: 1 Gm. (15 grains).

Official Preparation.—Liquor Potassii Citratis; an eight-per-cent solution of Citric Acid saturated with Potassium Bicarbonate.

The "Neutral Mixture," formerly official, was Lemon-juice neutralized with Potassium Bicarbonate.

Potassii Citras Effervescens, U. S.—A mixture of Potassium Citrate, 20 Gm., Sodium Bicarbonate 47.7 Gm., Tartaric Acid 25.2 Gm., Citric Acid 16.2 Gm., granulated by a gentle heat.

Dose: 4 Gm. (60 grains).

Potassium Ferrocyanide—$K_4Fe(CN)_6+3H_2O$—Potassii Ferrocyanidum, U. S.—From this nearly all the Cyanogen compounds are prepared. It is obtained by heating crude Potash in covered cast-iron pots with a mixture of Iron filings and Carbonaceous matters, such as horn, feathers, dried blood, etc. The

fused mass is lixiviated, and the clear liquid evaporated and crystallized.

Large, light-yellow, translucent or nearly transparent, quadratic pyramidal crystals. Soluble in 4 parts of water, insoluble in alcohol. Slightly deliquescent, heated to 60° begins to part with its water of crystallization, and at 100 it is completely given off, a white powder remaining. It is not poisonous.

Uses.—Used in the preparation of **Hydrocyanic Acid**, the Cyanides, etc., and as a test for iron, zinc and copper.

Dose: 0.5 Gm. (7½ grains).

Potassium Cyanide—KCN—Potassii Cyanidum, U. S.—Obtained by fusing together proper proportions of dried Potassium Ferrocyanide and Potassium Carbonate, dissolving out the Potassium Cyanide formed and crystallizing it.

Amorphous, or finely crystalline, white masses, deliquescent in moist air, with a penetrating odor resembling that of bitter almonds, and a sharp alkaline taste and reaction. Its fumes are poisonous when inhaled, and when taken internally the salt acts as a **violent poison.** As **antidote,** Ferric Hydroxide with Magnesia may be employed. It must be preserved in glass-stoppered bottles.

Dose: 0.01 Gm. (1-5 grain).

Uses.—Its medicinal properties and uses are similar to those of Hydrocyanic Acid, for which it is sometimes used (in the right proportion) because of being more stable. The commercial article is largely used in the arts for **gold mining,** plating, etc., but is usually too impure for medicinal purposes.

SODIUM.

Sodium resembles Potassium, and forms a similar series of compounds.

Sources.—Sodium does not occur native, but its compounds are abundant and widely distributed, Common Salt, Chili Saltpetre, Sodium Carbonate and Sodium Sulphate forming considerable deposits in some localities. The Silicates and Fluorides of Sodium are also common minerals.

Sodium—Na.—The symbol is derived from **Natrium,** the Nitrum of the ancients.

Metallic sodium is obtained by a process analogous to that used for obtaining potassium, but it is obtained with less difficulty than the latter metal and is therefore much cheaper.

A white **metal** with a silvery luster, sp. gr. 0.973, has the consistency of wax at ordinary temperature; when thrown on water forms the hydroxide and melts by the heat produced by its union with the oxygen of the water, but the freed hydrogen of the latter is not inflamed unless the melted sodium globule be restrained from moving about; when it **burns,** and the flame has a deep yellow color. It readily oxidizes in contact with moist air.

Uses.—The metal itself is not used in pharmacy, but its compounds are not less important than those of potassium.

Compounds of Sodium.

The three most common natural Compounds of Sodium are the Chloride, the Sulphate and the Nitrate.

Sodium Chloride—NaCl—Sodii Chloridum, U. S.—This is common "**salt,**" too familiar to require description. It is found native as Rock Salt in many parts of the world, and occurs in the sea, as well as in many lakes, and in plants and animals.

It is chiefly obtained in the States of New York, Michigan, West Virginia and Kansas from Salt-wells in the Earth, the brine being pumped to the surface and the Salt obtained by evaporation in vacuum apparatus; also from the Great Salt Lake in Utah.

Uses.—In pharmacy in the preparation of Chlorine gas, Hydrochloric Acid, Calomel, etc., and somewhat also in medicine, in washes, as a hæmostatic, and as **physiologic salt solution,** 0.6 per cent, in sterile water.

Sodium Sulphate—$Na_2SO_4+10H_2O$—Sodii Sulphas, U. S.—Commonly called Glauber's Salt. Frequently found native, and obtained as a by-product in many chemical processes.

Large, transparent, colorless, monoclinic prisms, which are odorless, with a cooling, saline, and a decidedly bitter taste. Efflorescent and crumbling to a white powder on exposure to dry air, neutral to test paper, soluble in 2.8 parts of water and insoluble in alcohol.

Uses.—As a purgative, chiefly in veterinary practice.

Dose: 16 Gm. (240 grains).

Sodium Nitrate—$NaNo_3$—Sodii Nitras, U. S.—Occurs native in extensive beds in Chili and Peru, and the crude article is called "Chili Saltpetre" or "Cubic Nitre."

Transparent, colorless, deliquescent, rhombohedral crystals. Neutral to test paper, inodorous, taste cooling, saline and bitterish. Soluble in 1.1 parts of water and nearly soluble in alcohol. Melts at 312°C., and at higher temperatures gives off oxygen, and is converted into the nitrite.

Uses.—Principal source of **Nitric Acid,** also used in preparing Sodium Arsenate. In medicine, chiefly as a diuretic.

Dose: 1 Gm. (15 grains).

In the arts as a substitute for Potassium Nitrate or the ordinary East India Saltpetre.

Sodium Nitrite—$NaNo_2$—Sodii Nitris, U. S.—It should contain not less than 90 per cent pure Sodium Nitrite. Obtained by heating Sodium Nitrate with some organic substance, such as Starch, or by fusing it with lead, forming Lead Oxide and Sodium Nitrite.

White opaque masses or in the form of pencils, deliquescent and changed to the nitrate by exposure to the air. Soluble in 1.4 parts of water, slightly soluble in alcohol.

Uses.—To yield Nitric Oxide in the preparation of **Spirit Nitrous Ether**; sometimes used internally.

Borax.—$Na_2B_4O_7+10H_2O$.—Sodii Boras, U. S., Sodium Borate. In crystalline, transparent, shining, colorless, somewhat efflorescent crystals, having a mild, cooling, and somewhat alkaline taste and reaction.

Soluble in 20 parts of water at 15°C. in one part of glycerin at 80°C., insoluble in alcohol; when heated parting with its water of crystallization, first swelling up into a porous mass and then fusing into a transparent glass.

Uses.—In various analytical operations in the laboratory, and in medicine, as ingredient of detergent antiseptic washes such as the Glycerite of Borax, and Honey of Borax, both formerly official. Borax is largely used in the powder form to destroy cockroaches, etc. It is used extensively to preserve meats and vegetables.

Dose: 0.5 Gm. (7½ grains).

Sodium Carbonate—$Na_2CO_3+10H_2O$—Sodii Carbonas, formerly official.—"Sal Soda;" exists in many mineral waters, the waters of certain lakes in hot and dry countries, and also in plants.

It is manufactured at Natrona, Pa., from the mineral **Cryolite** obtained from Greenland, which is a double Fluoride of Sodium and Aluminum, by boiling it with caustic Lime.

The **Leblanc** process consists in heating the Chloride with Lime and Coal and obtaining the carbonate by lixiviation in an impure form known as "**Soda Ash.**" From this the pure salt is obtained by crystallization.

It is also obtained by the **ammonia process** of Solvay, which consists in treating Sodium Chloride with Ammonia gas and Carbon Dioxide. Ammonium Chloride and Sodium Bicarbonate are formed, the latter precipitating because of its comparative insolubility. The Carbonate is easily obtained by heating the Bicarbonate, dissolving and crystallizing the residue.

Large, colorless, oblique rhombic crystals, or in irregular lumps, with a strongly alkaline reaction, and with an alkaline taste. On exposure to the air it effloresces and falls to a white powder. Insoluble in alcohol, soluble in 1.6 parts of water.

Sodii Carbonas Exsiccatus, "Dried Sodium Carbonate," made by exposing the crystals to the air, and then to a temperature of 45°C., until a white powder is formed. Was formerly official.

Monohydrated Sodium Carbonate—$Na_2CO_3+H_2O$—Sodii Carbonas Monohydratus, U. S.—Should contain not less than 85 per cent of pure anhydrous Sodium Carbonate [$CO.(ONa)_2$]. This is a new official introduced on account of its greater strength than the ordinary Sodium Carbonate, containing only

one molecule of water of crystallization instead of 10 molecules as in the latter.

White, crystalline, granular powder; exposed to air absorbs very little moisture, heated to 100°C. loses its water of crystallization, 14.5 per cent. Soluble in 2.9 parts water, in 1.8 parts boiling water, insoluble in alcohol ether, soluble in 8 parts glycerin.

Uses.—In the preparation of various Sodium compounds, in **Suppositories of Glycerin,** etc.

Dose: 0.25 Gm. (4 grains).

Sodium Bicarbonate—$NaHCO_3$—Sodii Bicarbonas, "Baking Soda."—Made from the Carbonate by exposing it to Carbon Dioxide.

White powder, permanent in air, odorless, cooling, saline taste, and alkaline reaction. Soluble in 12 parts of water, insoluble in alcohol. The aqueous solution if heated gives up a part of its carbon dioxide and becomes a solution of the carbonate.

Uses.—For the preparation of various other sodium compounds, in medicine as an antacid to furnish Carbonic Acid to draughts and in the manufacture of Baking Powder.

Dose: 1 Gm. (15 grains).

Official Preparations.—Mistura Rhei et Sodæ; Pulv. Effervescences comp.; Trochisci Sodii Bicarbonatis, 0.2 Gm. in each.

Sodii Bicarbonas Venalis.—Common, impure commercial sodium bicarbonate was formerly official.

Sodium Hydroxide—$NaOH$—Sodii Hydroxidum, U. S.—Soda (U. S. 1890), "Caustic Soda," should contain not less than 90 per cent pure anhydrous Sodium Hydroxide and not more than 2 per cent of other inorganic impurities, with the exception of water. It should be kept in well-stoppered bottles made of hard glass. It must be **handled with great care,** since it destroys organic tissues.

The process of manufacture is similar to that of potassa, consisting in decomposing a solution of Sodium Carbonate with Lime. The insoluble Calcium Carbonate formed precipitates, and the Sodium Hydroxide is obtained upon evaporation of the solution.

Caustic soda closely resembles caustic potassa in appearance and properties, and is usually cast in pencils in the same way. Soluble in 1 part of water, in 0.8 part boiling water and freely soluble in alcohol. Its aqueous solution, after acidulating with acetic acid, causes no precipitate with tartaric acid; **distinction from Potassa.**

Uses.—Similar to potassa.

Official Preparation.—Liquor Sodii Hydroxidi—5%$NaOH$—made either from Sodium Carbonate and Lime, or by dissolving 56 Gm. Caustic Soda in Water to make 1000 Gm. similarly to the process for Solution of Potassium Hydroxide.

Sodium Chlorate—$NaClO_3$—Sodii Chloras, U. S.—Obtained by

the action of Chlorine on a solution of Soda, by a process analogous to that for the corresponding salt of potassium.

Transparent, tetrahedral crystals, permanent in the air, odorless, cooling, saline taste, and neutral reaction. Yields up its oxygen when heated, leaving common salt as the residue. Soluble in 1 part water, very sparingly in alcohol.

Caution.—If triturated with organic or other easily oxidizable compounds, explosion is liable to occur and the same precautions must be taken in storing, handling and mixing it as are directed in the case of Potassium Chlorate.

Uses.—Similar to those of Potassium Chlorate.

Dose: 0.25 Gm. (4 grains).

Sodium Bromide—NaBr—Sodii Bromidum, U. S.—Obtained by double decomposition between Ferrous Bromide and Sodium Carbonate by a process similar to that employed for potassium bromide.

A white crystalline powder or small white monoclinic crystals, permanent in dry air, odorless, having a saline taste, and a neutral or faintly alkaline reaction. Soluble in 1.2 parts of water and in 13 parts of alcohol, and fusing without loss of weight at a dull-red heat.

Uses.—Same as those of Potassium Bromide. An unofficial **Elixir** containing 10 grains to the fluid-dram. [See National Formulary.]

Dose: 1 Gm. (15 grains).

Sodium Iodide—NaI—Sodii Iodidum, U. S.—Obtained by the reaction of Iodine on Soda and the conversion of the Iodate into Iodide by the same method employed in making potassium iodide.

A white powder or small, colorless or transparent, monoclinic crystals. Deliquescent, inodorous, and having a bitterish saline taste. Soluble in 0.5 part of water and 3 parts of alcohol. Melts at a dull-red heat, and at a higher temperature volatilizes with partial decomposition.

Uses.—Same as that of Potassium Iodide.

Dose: 0.5 Gm. (7½ grains).

Sodium Sulphite—$Na_2SO_3+7H_2O$—Sodii Sulphis, U. S.—Prepared by neutralizing a solution of Sodium Carbonate with Sulphurous Acid gas, evaporation and crystallization.

Transparent, colorless, monoclinic prisms, odorless, with cooling, saline and somewhat sulphurous taste, and slightly alkaline reaction. Effloresces and gradually changes to the sulphate on exposure to the air. Soluble in 2 parts of water and but slightly soluble in alcohol. When heated it first melts, then loses its water of crystallization, and finally is decomposed, giving off sulphurous gas.

Uses.—In medicine similar to those of potassium sulphite as an antifermentative, etc.

Dose: 1 Gm. (15 grains).

Sodium Bisulphite—$NaHSO_3$—Sodii Bisulphis, U. S.—Made

by saturating a cold solution of Sodium Carbonate with Sulphurous Acid gas, evaporation and crystallization.

A white granular powder or opaque prismatic crystals, odor faintly sulphurous, taste disagreeable, undergoing decomposition on exposure to the air. Soluble in 3.5 parts of water and in 72 parts of alcohol.

Uses.—Similar to those of the normal sulphite.

Dose: 0.5 Gm. (7½ grains).

Sodium Thiosulphate—$Na_2S_2O_3+5H_2O$—Sodii Thiosulphas, U. S.—Sodium Hyposulphite (U. S. 1890). Usually prepared by heating together the proper proportions of Sulphur and dried Sodium Carbonate, stirring vigorously to facilitate oxidation, and then converting the normal Sulphite thus formed into the Thiosulphate by dissolving it in Water and boiling it with Sulphur. It is also prepared by decomposition of Calcium Thiosulphate with Sodium Carbonate, or Sulphate.

Monoclinic, prismatic or tabular crystals, permanent in the air, transparent, colorless, inodorous, and with a sulphurous, cooling and alkaline taste. Soluble in 0.35 part of water and insoluble in alcohol, decomposed in boiling water. On heating, it first loses its water of crystallization and then is decomposed with the separation of sulphur.

Uses.—In medicine, for its anti-putrefactive and **anti-fermentative** properties, chiefly. In the arts, in the manufacture of paper and in **photography** as a solvent for bromide, or chloride, of silver.

Dose: 1 Gm. (15 grains).

Preparations.—The Volumetric Test Solution and in the so-called:

Tinctura Iodi Decolorata.—Prepared by digesting Iodine and Sodium Thiosulphate in water, until a dark, brownish-red solution results; adding Alcohol and Stronger Water of Ammonia and shaking until the solution has become colorless. [See National Formulary.]

Sodium Phenolsulphonate—$NaC_6H_5O_4S+2H_2O$—Sodii Phenolsulphonas, U. S.—Sodium Sulphocarbolate (U. S. 1890) should contain not less than 99 per cent pure Sodium Paraphenolsulphonate [$C_6H_4(OH)SO_3NaI:42H_2O$]. Obtained by the reaction of Barium Sulphocarbolate in solution, upon Sodium Carbonate or Sodium Sulphate.

Rhombic prismatic crystals, which are colorless or slightly pinkish, transparent, permanent in the air, inodorous, with a bitterish, saline taste. Soluble in 4.8 parts of water and in 130 parts of alcohol. When heated it first loses its water of crystallization, then decomposes, giving off the odor of carbolic acid, leaving behind a charred mass.

Uses.—It has much the same medicinal value as carbolic acid, but is much milder in its action.

Dose: 0.25 Gm. (4 grains).

Sodium Phosphate—$Na_2HPO_4+12H_2O$—Sodii Phosphas, U. S. —Di-Sodium-ortho-phosphate. Prepared by a somewhat com-

plicated process from Bone-ash, Sulphuric Acid and Sodium Carbonate.

Transparent, colorless, monoclinic, prisms of large size, efflorescent on exposure to the air, inodorous and with a cooling, saline or somewhat alkaline taste, and a slightly alkaline reaction. Soluble in 5.5 parts of water and insoluble in alcohol. When heated to 40°C. the salt fuses, yielding a colorless liquid; at 100°C. it loses its water of crystallization and at 300°C. it is converted into the pyrophosphate.

Uses.—For the preparation of the Sodium Pyrophosphate, of Iron Phosphate, etc. In medicine mainly for its mildly purgative effects.

Dose: 2 Gm. (30 grains).

Sodii Phosphas Exsiccatus, U. S.—Dried Sodium Phosphate. Obtained from the Phosphate by exposing it to the air and then to a temperature of 100°C. until it ceases to lose weight and falls to a powder.

Sodii Phosphas Effervescens, U. S.—Effervescent Sodium Phosphate. Prepared from Dried Sodium Phosphate, 20 parts; Sodium Bicarbonate, 47.7 parts; Tartaric Acid, 25.2 parts, and Citric Acid, 16.2 parts, powdered and the mixture warmed and obtained in granules by stirring.

Dose: 8 Gm. (120 grains).

Sodium Pyrophosphate—$Na_4P_2O_7+10H_2O$—Sodii Pyrophosphas, U. S.—Prepared by heating the phosphate to 300°C.

Translucent, colorless, monoclinic prisms, permanent in the air, odor and taste like the phosphate, soluble in 12 parts of water and insoluble in alcohol.

Uses.—Chiefly for the preparation of Iron Pyrophosphate.

Sodium Hypophosphite—$NaPH_2O_2+H_2O$—Sodii Hypophosphis, U. S.—Made by the neutral reaction of Sodium Carbonate and Calcium Hypophosphite, in solution and crystallization.

A white powder, or colorless rectangular tabular crystals, very deliquescent, odorless, with a saline, slightly sweetish taste, soluble in 1 part of water and 30 of alcohol. When heated strongly, it first loses its water of crystallization, and then undergoes decomposition.

Caution: Should be handled with care, as it is liable to react violently when triturated or heated with oxidizing agents.

Uses.—In medicine, in treatment of phthisis, bronchitis, and in nervous debility.

Dose: 1 Gm. (15 grains).

Official Preparations.—Syrupus Hypophosphitum; Syrupus Hypophosphitum Compositus; Emulsum Olei Morrhuæ cum Hypophosphitibus; and in unofficial Elixirs, etc. [See Nat. Form.]

Sodium Arsenate—$Na_2HAsO_4+7H_2O$—Sodii Arsenas, U. S.—Disodium Ortho-arsenate (98 per cent). Made by fusing together in the proper proportions Sodium Carbonate and Nitrate with Arsenous Acid, treating the fused mass with Water and crystallizing.

Colorless, transparent, prismatic crystals, that are odorless, and have a somewhat alkaline taste. Somewhat deliquescent, soluble in 1.2 parts of water, very sparingly in alcohol. It is poisonous.

Dose: 0.005 Gm. (1-10 grains).

Uses.—Similar to those of Fowler's Solution.

Sodii Arsenas Exsiccatus—U. S. Dried Sodium Arsenate—should contain not less than 98 per cent pure anhydrous Disodium Ortho-Arsenate prepared from the Crystallized Arsenate by allowing it to effloresce, then heating to 150° C. until it ceases to lose weight and it falls to a powder.

Dose: 0.003 Gm. (3 mg.—1-20 grain).

Official Preparation.—Liquor Sodii Arsenatis.

Sodium Acetate—$NaC_2H_3O_2+3H_2O$—Sodii Acetas, U. S.—Made by saturating a solution of Sodium Carbonate, or Bicarbonate, with Acetic Acid, evaporation and crystallization.

Colorless, transparent, monoclinic prisms or a granular crystalline powder, odorless, slightly alkaline, of a bitterish, saline taste and efflorescent in dry air. Soluble in 1 part of water and in 23 parts of alcohol. At 60°C. the crystals melt, at 123°C. give off their water of crystallization, and at a higher temperature the mass blackens and decomposes.

Uses.—Similar to those of Potassium Acetate, to which it is sometimes preferred because of its milder action.

Dose: 1 Gm. (15 grains).

Sodium Benzoate—$NaC_7H_5O_2$—Sodii Benzoas, U. S.—Made by neutralizing a solution of Benzoic Acid with Sodium Carbonate, evaporation, crystallization, or granulation.

White, semi-crystalline or amorphous powder, usually with a faint odor of benzoin, a sweet, astringent taste, and neutral reaction. It is soluble in 1.6 parts of water and in 43 parts of alcohol.

Uses.—In gout, rheumatism and renal disorders.

Dose: 1 Gm. (15 grains).

Sodium Citrate—$2Na_3C_6H_5O_7+11H_2O$—Sodii Citras, U. S.—Obtained by neutralizing a solution of Citric Acid with Sodium Carbonate, concentration and crystallization.

A white crystalline powder, soluble in 1.1 parts water, slightly soluble in alcohol.

Uses.—Refrigerant, diuretic.

Dose: 1 Gm. (15 grains).

Sodium Salicylate—$NaC_7H_5O_3$—Sodii Salicylas, U. S.—Prepared by the reaction of Salicylic Acid on Soda, or on Sodium Carbonate, in Water, concentration and crystallization.

White, tabular crystals of small size, or in the form of a white, crystalline powder. Inodorous, saline, and somewhat sweetish taste, and slightly acid reaction. Dissolves in 0.8 part of water and in 5.5 parts of alcohol. Decomposed by heat, giving off inflammable vapors and leaving a charred mass.

Uses.—In medicine, mainly in the treatment of rheumatism. Solution conveniently prepared from salicylic acid and sodium bicarbonate.

Dose: 1 Gm. (15 grains).

Sodium Santoninate.—Made by the reaction of Soda on Santonin, in the presence of Water, and crystallizing the salt was official in the U. S. Ph., 1880.

It was used in the form of troches, but since the Sodium Salt of Santonin has proved to be unreliable as a worm-destroyer the substance and the troches have both been discarded.

LITHIUM—Li.

Lithium does not exist free in nature, and its compounds are much less abundant than either those of potassium or sodium. It occurs in certain minerals, as lepidolite, spodumene, petalite, etc.; in certain mineral waters, in minute quantities in sea-waters and even in most fresh waters. It occurs also in many plants.

The **metal**, which is too expensive to be more than a scientific curiosity, is obtained by electrolysis from the chloride. It bears a close resemblance to potassium and sodium in its properties. It is the **lightest** of all known metals, having a sp. gr. of only 0.5891.

The following Compounds of Lithium are official:

Lithium Carbonate—Li_2CO_3—Lithii Carbonas, U. S.—Obtained from the Chloride by treating its solution with Ammonium Carbonate.

A light, white powder, odorless and having an alkaline taste; permanent in the air. Soluble in 75 parts of water, in 140 parts of boiling water; much more soluble in Carbonic Acid Water; insoluble in alcohol.

Uses.—In medicine as a **solvent for uric acid deposits** and gouty concretions; also as a remedy for gouty and rheumatic affections.

Dose: 0.5 Gm. (7½ grains).

From the Carbonate all the other Lithium compounds are easily made.

Lithium Bromide—LiBr—Lithii Bromidum, U. S.—Is made from the Carbonate by decomposing it with Hydrobromic Acid.

A white granular salt, odorless, and having a sharp, slightly bitter taste; very deliquescent. Soluble in 0.6 part of water and 0.3 part of boiling water; very soluble in alcohol; also soluble in ether.

Uses.—It has the same medicinal virtues as the other bromides, only, it is claimed, in a higher degree, because more soluble and containing a larger proportion of bromine.

Dose: 1 Gm. (15 grains).

Lithium Benzoate—$LiC_7H_5O_2$—Lithii Benzoas, U. S.—Made from the Carbonate by decomposing it with Benzoic Acid.

A light, white powder or small, shining, crystalline scales; odorless or of a faint benzoin-like odor and of a cooling, sweetish taste. Soluble in 3 parts of water and in 12 parts of alcohol.

Uses.—In medicine as a substitute for sodium benzoate.

Dose: 1 Gm. (15 grains).

Lithium Citrate—$Li_3C_6H_5O_7 4H_2O$—Lithii Citras, U. S.—Made from the Carbonate by saturating a solution of it with Citric Acid.

A white powder, odorless, and having a cooling, faintly alkaline taste; deliquescent on exposure to air. Soluble in 2 parts of water; almost insoluble in alcohol or ether.

Uses.—Similar to those of the carbonate.

Dose: 0.5 Gm. (7½ grains).

Lithii Citras Effervescens—U. S.—A mixture of Lithium Citrate, 5 parts; Citric Acid, 19.5 parts; Sodium Bicarbonate, 57 parts; Tartaric Acid, 30 parts, granulated by application of gentle heat and stirring.

A convenient form of administering Lithium Salts.

Dose: 8 Gm. (120 grains).

Lithium Salicylate—$LiC_7H_5O_3$—Lithii Salicylas, U. S.—Produced by the action of Salicylic Acid upon the Carbonate.

A white or grayish white, deliquescent powder, odorless and having a sweetish taste; very soluble in water or alcohol.

Uses.—Similar to those of potassium and sodium.

Dose: 1 Gm. (15 grains).

THE ALKALINE EARTHS.

The alkaline earths include the elements **Barium, Calcium, Strontium** and **Magnesium.**

Barium—Ba.

Barium occurs in nature chiefly in the form of Sulphate or **heavy-spar,** and as Carbonate or Witherite. The metal, obtained by electrolysis, possesses a bright, yellow color, and burns brilliantly when heated in the air.

There is no compound of barium official, but some of them are used in chemistry and in the arts, the chloride as a chemical reagent, the sulphate as a **pigment** and the nitrate in **pyrotechny.**

Barium Dioxide—BaO_2—Barii Dioxidum (U. S. 1890).—Barium Peroxide. Prepared by conducting oxygen over Barium Oxide heated to redness.

A heavy, grayish-white, amorphous powder, odorless and tasteless. When exposed to the air, it slowly attracts moisture and carbon dioxide, and is gradually decomposed. It should be kept in well-closed vessels.

Almost insoluble in cold water, with which, however, it forms a definite hydrate, and to which it imparts a decidedly alkaline reaction. Hydrochloric, phosphoric, and most other mineral acids decompose it, producing the corresponding barium salts, and hydrogen dioxide, which remains in solution for a considerable time, if the reaction has taken place in the cold, and an excess of the acid is present. Owing to this property it is used for the preparation of Aqua Hydrogenii Dioxidi, U. S. Ph.

Calcium—Ca.

Calcium is an abundant metal in nature, being represented by a large number of compounds, several of which, like Limestone or native Calcium Carbonate and the Sulphate, or "Gypsum," constitute no inconsiderable portion of the earth's crust.

The **metal** itself, although it has been isolated and studied, is rarely used outside the chemical laboratory and for the production of artificial **light.**

It is obtained by electrolysis, and is a yellow metal harder than lead, malleable, tough, or in some conditions brittle; undergoes oxidation slowly in dry air, rapidly in damp air, and when thrown into water decomposes it with rapid evolution of hydrogen.

Lime—CaO—Calx, U. S.—Calcium Oxide. It should contain not less than 90 per cent pure Calcium Oxide. Made by calcining white marble, oyster-shells, or the purest varieties of natural Calcium Carbonate, or Limestone. Carbon dioxide and water are expelled, and Lime or Calcium Oxide remains.

Grayish-white masses, which upon exposure to air gradually attract moisture and carbonic acid gas, and fall into a white powder. When moistened with water the latter is absorbed with the liberation of heat, the lime being hydrated, commonly termer "**slaked.**" Mixed with 3 or 4 times its weight of water, slaked lime forms a uniform, smooth magma called "**milk of lime.**" It is soluble in 760 parts of cold water, much less in boiling water, 1,600 parts.

Lime or burnt lime must be protected from moisture and air, and slaked lime should be prepared when wanted.

Uses.—For dehydrating various substances, such as alcohol and ether; in the preparation of alkalies and alkaloids and certain organic acids. In preparing Chlorinated Lime, Potassium Chlorate, etc.

Official Preparations.—Liquor Calcis, a saturated solution of Lime in Distilled water; Syrupus Calcis, and Potassa cum Calce, formerly official.

Sulphurated Lime.—Calx Sulphurata, U. S.—Commonly misnamed "Calcium Sulphide," a mixture containing at least 60 per cent Calcium Sulphide, Calcium Sulphate and Carbon in varying proportions, prepared by fusing together dried Calcium Sulphate, Charcoal and a little Starch.

Uses.—As a depilatory, and internally in skin diseases.

Dose: 0.065 Gm. (1 grain).

Calcium Compounds.

Prepared Chalk—$CaCO_3$—Creta Preparata, U. S.—Native Calcium Carbonate freed from most of its impurities by **elutriation.**

White, amorphous powder, usually appearing in commerce in the form of small cones or drops; insoluble in water.

Uses.—Medicinally in many compounds, also largely in **Face Powders** and **Dentifrices.**

Official Preparations.—Hydrargyrum cum Creta, Pulvis Cretæ Compositus for Mistura Cretæ, and Trochisci Cretæ (U. S. 1890).

Calcium Chloride—$CaCl_2$—Calcii Chloridum, U. S.—Obtained by the reaction of Hydrochloric Acid on Marble, or other Calcium Carbonates and rendered anhydrous by fusion at the lowest possible temperature.

Hard, white masses, which have a pungent, saline and bitter taste. It is a very deliquescent salt and must be kept in well-stoppered bottles.

Uses.—As a valuable **test reagent** in the pharmaceutical laboratory, for **drying** certain gases and liquids, and in the preparation of certain Calcium compounds. In medicine also as a resolvent.

Dose: 0.5 Gm. (7½ grains).

Precipitated Calcium Carbonate—$CaCO_3$—Calcii Carbonas Præcipitatus, U. S.—It is produced by the double decomposition of Calcium Chloride and Sodium Carbonate.

Impalpable, white powder, without odor or taste, having a neutral reaction and insoluble in water. At a red heat it gives off carbon dioxide, and is converted into calcium oxide.

Uses.—As an astringent and antacid in medicine, and largely as an ingredient in **Face Powder** and **Dentifrices.**

Precipitated Calcium Phosphate—$Ca_3(PO_4)_2$—Calcii Phosphas Præcipitatus, U. S.—Obtained from a dilute solution of Bone-Ash in Hydrochloric Acid by precipitation with Ammonia. The precipitate is in the form of a light-white powder, which at a red heat fuses, and on cooling forms a hard, porcelain-like mass.

Uses.—Formerly in preparing Syrup of Calcium Lactophosphate and in medicine for the same purposes as the hypophosphite; also as a **filtering medium.**

Calcium Bromide—$CaBr_2$—Calcii Bromidum, U. S.—Made by dissolving Calcium Carbonate in Hydrobromic Acid.

Whitish salt in granules or powder, without odor, and a saline, bitter taste. It deliquesces in the air, is soluble in 0.5 part of water and 1 part of alcohol, melts at a red heat, and at that temperature begins to give off bromine.

Uses.—Similar to those of the other bromides.

Dose: 1 Gm. (15 grains).

Calcium Hypophosphite—$Ca(PH_2O_2)_2$—Calcii Hypophosphis, U. S.—Obtained by heating Phosphorus with Milk of Lime.

Thin, colorless, transparent and flexible scales, or in white, pearly, lustrous crystalline powder. Neutral, or slightly alkaline, odorless, and of a disagreeably bitter taste. Soluble in 6.5 parts of water, in 6 parts of boiling

water, insoluble in alcohol. Should be handled with care, as it may cause explosion.

Uses.—In the preparation of **Syrup of Hypophosphites** and various unofficial **Syrups, Elixirs** and **Emulsions** used in the treatment of pulmonary diseases, etc. [See Nat. Form.] Also for preparing other Hypophosphite Salts.

Dose: 0:5 Gm. (7½ grains).

Official Preparations.—Syrupus Hypophosphitum, Syrupus Hypophosphitum Comp. and Emulsum Olei Morrhuæ cum Hypophosphitibus.

Strontium—Sr.

Strontium occurs in nature as Sulphate and Carbonate, the latter being a mineral found in Scotland and in a cave in "Put-in Bay" in Lake Erie, termed Strontianit, whence the name of the element is derived. It is also found in small quantities in barytes, gypsum, limestone, sea-water and in some mineral waters.

The **metal** is obtained from the chloride by electrolysis and is a yellow ductile metal having a sp. gr. of 2.5.

The Salts of Strontium have much the same character as those of Barium. They are all made from the Carbonate or from the Hydroxide which is itself produced by heating the Nitrate, the most common commercial Strontium compound. The **Nitrate** is largely used in **red-fire** owing to the bright-red color of its flame, when burned. It is not official.

Strontium Bromide—$SrBr_2+6H_2O$—Strontii Bromidum, U. S.—Made by reaction of Hydrobromic Acid on Strontium Carbonate.

Colorless, transparent, hexagonal crystals, odorless and having a saline, bitter taste, very deliquescent and should be kept in glass-stoppered vials. Soluble in 1 part of water, readily in alcohol and precipitated from its alcoholic solution by ether, in which it is insoluble.

Uses.—Similar to other Bromides.

Dose: 1 Gm. (15 grains).

Strontium Iodide—SrI_2+6H_2O—Strontii Iodidum, U. S.—Made by reaction of Hydriodic Acid on Strontium Carbonate.

Colorless, transparent hexagonal plates, odorless and having a bitterish, saline taste. Deliquescent and colored yellow by exposure to air and light and should, therefore, be kept in dark, amber-colored, glass-stoppered vials. Soluble in 0.5 part of water, also in alcohol and slightly in ether.

Uses.—Similar to other Iodides.

Dose: 0.5 Gm. (7½ grains).

Strontium Salicylate.—$Sr(C_7H_5-O_3)_2+2H_2O$—Strontic Salicylas U. S. By action of Strontium Carbonate with Salicylic Acid in solution.

A white, crystalline powder, soluble in 18 parts water, 66 parts alcohol.
Uses.—Same as other salicylates.
Dose: 1 Gm. (15 grains).

Strontium Lactate—$Sr(C_3H_5O_3)_2+3H_2O$—Strontii Lactas (U. S. 1890).

A white, granular powder, or crystalline nodules, permanent in the air, odorless and having a slightly bitter, saline taste. Soluble in alcohol and in 4 parts of water.

Uses.—In affections of the heart and kidneys in doses from 1 to 3 Gm.

Magnesium—Mg.

Although an abundant metal, magnesium is not free in nature. It occurs in the minerals, magnesite, dolomite, kieserite, asbestos, talc, soapstone, meerschaum and many others; it occurs as the Sulphate in many saline springs, notably those at **Epsom,** England; as Chloride in sea-water, and in many salt springs, and it is also found in the bones of animals, and the tissues of many plants.

The **metal** is obtained from its Chloride, or the double Chloride of Magnesium and Potassium, by heating it, together with fluor spar and sodium, in a red-hot iron crucible, and afterward distilling, avoiding contact with the air, when the crude metal is obtained.

Brilliant silver-white metal, soon tarnishing in damp air, sp. gr. 1.75. Melts at a red heat, and may be inflamed, when in the form of rather fine **wire** or ribbon, by holding it in a candle, when it **burns** with an intensely active flame, producing a bulky white oxide.

The metal itself is not of pharmaceutical importance, its chief use being to produce a strong dazzling light similar to that of calcium.

The most common compound is the Sulphate and from this all the other medicinal compounds are indirectly produced.

Magnesium Sulphate—$MgSO_4+7H_2O$—Magnesii Sulphas, U. S.—Commonly known as Epsom Salt. It occurs native, as has already been stated, and is also manufactured from the mineral **kieserite,** which, aside from its impurities, differs in composition from Epsom salt only in having six molecules less of water of crystallization.

Four-sided rhombic prisms or acicular crystals without odor, taste saline and bitter, soluble in 0.85 part water, in 0.13 parts boiling water, insoluble in alcohol.

Use.—In the preparation of the carbonate, and in medicine as a purgative.

Dose: 16 Gm. (240 grains).

Official Preparation—Infusum Sennæ compositum.

Magnesium Carbonate—$(MgCO_3)_4+Mg(OH)_2+5H_2O$—Mag-

nesii Carbonas, U. S.—It will be seen from the formula that the official carbonate is really a mixture of the Carbonate and Hydroxide. It is made by the reaction in solution of Sodium Carbonate and Magnesium Sulphate. It should yield on ignition 40 per cent residue magnesium oxide.

A very light white powder or friable masses, nearly insoluble in both alcohol and water, but giving to the latter a slight alkaline reaction. Dissolves with effervescence in hydrochloric acid.

Uses.—For the preparation of Magnesia, **Liquor Magnesii Citratis** and other compounds, and in medicine for similar purposes as magnesia; also as a **Face Powder.**

Dose: 3 Gm. (45 grains).

Magnesii Sulphas Effervescens, U. S.—A granular powder obtained by mixing dried Magnesium Sulphate 25 parts, Sodium Bicarbonate 40 parts, Tartaric Acid 21 parts, Citric Acid 13 parts, warming the mixture and granulating it by stirring.

Uses.—To furnish effervescent purgative draughts.

Dose: 16 Gm. (240 grains).

Magnesium Oxide—MgO—Magnesii Oxidum, U. S.—Magnesia.—Calcined, or "Light" Magnesia. Obtained by igniting (calcining) the Carbonate.

A very white and light powder, which on exposure to the air slowly absorbs carbon dioxide and becomes converted into the carbonate. It should therefore be kept in tightly-stoppered bottles.

Uses: In medicine chiefly as a corrective to acidity in the alimentary tract.

Dose: 2 Gm. (30 grains).

Official Preparation—Ferri Hydroxidum cum Magnesii Oxido: Pulvis Rhei compositus.

Heavy Magnesium Oxide—Magnesii Oxidum Ponderosum, U. S.—"Heavy Magnesia"—is similar to the above, except in possessing only one-fourth the bulk, which facilitates its administration.

It is prepared by calcining the **heavy** Carbonate; the latter is produced in the same way as the ordinary carbonate, except that the Magnesium Sulphate and Sodium Carbonate are used in **hot, concentrated** solutions.

Magnesium Sulphite—$MgSO_3+6H_2O$—Magnesii Sulphis—Made by the reaction of Sulphurous Acid on Magnesia or Magnesium Carbonate. Not official.

White, crystalline, colorless and bitterish powder, with a sulphurous taste; changes to the sulphate gradually on exposure to the air, and hence should be kept in tightly-stoppered bottles.

Uses.—Similar to those of sodium sulphite.

Talc—Talcum, U. S.—A native hydrous Magnesium Silicate. A grayish-white powder; when rubbed on the Skin imparts a greasy feeling.

Insoluble in water and in dilute solutions of acids and alkalies.

Uses.—As a filtering medium, for which the following is preferred:

Talcum Purificatum, U. S.—Purified Talc.—Prepared by boiling Talc with water and Hydrochloric Acid, decanting and again boiling with diluted Acid, finally washing and drying.

QUESTIONS ON LECTURE V—SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink,** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answer and preserve it for future use.

In order to insure prompt attention, all the rules of the "Important Notice" must be complied with.

The Director.

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1. Name the three "Caustic Alkalies" and give their formulas.
2. Why are they called "Caustic?"
3. What are the three **chemical** properties of the Alkalies?
4. How is the strength of Alkalies determined?
5. How do the Alkali metals differ **physically** and **chemically** from the Non-metals?
6. From what is Ammonia Gas obtained, and how are the Hydrate, Chloride, Carbonate and Acetate respectively produced?
7. What **physical** characteristic distinguishes the compounds Ammonium from the compounds of the proper Alkali-Metals?
8. What is Ammonium Carbonate, U. S. Ph., chemically? What official Preparations does it enter into?
9. In what general way are most of the Ammonium Salts made?
10. What is the therapeutic property of the Ammonium Salts?
11. What is the dose of Ammonium Chloride? (b) What is the common name for Ammonium Carbonate?
12. What **purpose** does the presence of Ammonium Citrate serve in Bismuth and Iron solutions?
13. What is **formed** in solution when metallic K is thrown into water?
14. Name the four **natural** compounds of Potassium, with their chemical formulas.
15. Mention the official Latin and English Titles of the following: Saltpetre, Chili Saltpetre, Cream of Tartar, Sal Rochelle, and Salts of Tartar.
16. What is the principal use for $KClO_3$ in the arts and

medicine? What **precautions** must be observed in handling this salt, and why?

17. What are the Chemical formulas for Potassium Bromide and Iodide?

18. What prominent characteristic is common to Potassium Carbonate, Citrate and Acetate as regards exposure to the atmosphere?

19. How are Liquor Potassii Citratis and Potassii Citras Effervescens, U. S. Ph., prepared?

20. What is KCN; how and from what is it prepared?

21. Mention the official Latin and English Titles for the following: "Sal Ammoniac," "Salt," Glauber salt," "Sal Soda," and "baking soda."

22. How many Sodium Bicarbonate be prepared from a solution of the Carbonate, and what Official Preparations does it enter into?

23. How is Sodium Nitrate prepared? What is its **principal** use?

24. What is Soda? How may Liquor Sodii Hydroxidi be prepared?

25. What Official Preparation is made from Sodium Arsenate?

26. State the chemical formula and the official Latin and English Titles of Sodium Thiosulphate; also its use in medicine and the arts.

27. What precaution is essential in the evaporation of a solution of Sodium Salicylate in order to obtain a "white" salt?

28. Give the official Latin and English titles for: Cubic Nitre, Prussiate of Potash, Hepar Sulphuris.

29. What **colors** are imparted to a non-luminous flame respectively by compounds of Potassium, Sodium, and Lithium, and how may the color of K be recognized in the **presence** of the color of Na?

30. How may Sodium Acetate, Benzoate, and Salicylate be prepared **extemporaneously** in solution.

31. Mention the characteristic reactions of Lithium salts.

32. Mention all the Official Lithium Compounds and from **which** of these may the rest be prepared?

33. How is Lithii Citras Effervescens, U. S. Ph., prepared and in what doses may it be administered?

34. What compound of Lithium are the "Lithia Tablets" sold in drug stores?

THE ALUMINUM GROUP.

This group includes the elements Aluminum, Cerium and Chromium.

ALUMINUM—Al.

This metal does not exist free in nature, although, with the exception of oxygen and silicon, it is the most abundant and widely distributed of the elements.

It occurs as the oxide in Corundum, of which **emery,** ruby and sapphire are varieties; in the minerals, cryolite, bauxite and diaspor; in the different kinds of Feldspars, which make up a considerable portion of the weight of granite, syenite, gneiss, mica, porphyry, and so on; in **kaolin** and the **clays,** which are essentially Silicates of aluminum. The element is therefore, contained in abundance in all fertile soils.

The metal is produced from its ores by reducing these with Carbon and the intense heat produced by an electric furnace.

Aluminum.—Al.—A tin-white, very sonorous metal, capable of receiving a high polish, very malleable, ductile, and tough, sp. gr. from 2.56 to 2.67, conducts electricity eight times better than iron, oxidizes but little, and produces, with copper and other metals, a series of **alloys,** some of which have exceedingly valuable properties.

The metal free from arsenic is used for testing purposes in the form of foil, wire or ribbon. It undergoes slight oxidation upon exposure, but the oxide is of the same color as the metal and articles made from aluminum do not, therefore, become discolored, or **rust,** as is the case with iron, copper, etc. Aluminum vessels should not be used for **strong alkalies** as the metal is easily affected by alkaline hydrates.

Compounds of Aluminum.

Alum.—$AlK(SO_4)_2+12H_2O$.—Alumen. U. S.—Potassa Alum. —The double Sulphate of Aluminum and Potassium. Formerly by treating Clay with Sulpuric Acid, now from the Mineral Cryolite as a product in making Soda.

Ammonia alum is produced by adding Ammonium Sulphate to the Aluminum Sulphate.

Transparent, colorless, inodorous crystals of large size, which are octahedra, or octahedra combined with cubes, having a very astringent and somewhat acid taste, and an acid reaction. Effloresces somewhat on exposure to air, dissolves in 9 parts of water, in 0.3 part boiling water, freely soluble in warm glycerin, but is insoluble in alcohol. Fuses at 92°C. in its water of crystallization, and again solidifies at a higher temperature; when the water has evaporated the porous mass remaining as lost nearly one-half (45 per cent) of its original weight and constitutes the **"dried"** or **"burnt alum," Alumen Exsiccatum,** U. S.

Uses.—In pharmacy, for the preparation of other compounds of aluminum as a precipitant and in the **purification** of Water by precipitation (when

care should be observed that the Ammonia Alum be not employed). In medicine, on account of its acid and astringent properties, and in the powdered form an as emetic.

Alumen Exsiccatum, U. S.—Exsiccated or "Dried Alum." Alum which has been deprived of water by moderate heat, 55 parts being obtained from 100 parts of Alum.

Dose.—0.5 Gm. (7½ grams).

Aluminum Hydroxide.—$Al(OH)_3$.—Alumini Hydroxidum, U. S.—Aluminum Hydrate (U. S. '90)—occasionally found native, but usually prepared from Alum by precipitating it with Sodium Carbonate in hot solution.

Amorphous, white, odorless and tasteless powder insoluble in water or alcohol. At a red-heat loses water, and is converted into the oxide.

Uses.—In medicine, as an antacid, and as a protective to the mucous membranes; and, in pharmacy, for preparing the Sulphate.

Aluminum Sulphate.—$Al_2(SO_4)_3+16H_2O$.—Alumini Sulphas, U. S.—For medicinal use, prepared from Aluminum Hydrate by treating it with dilute Sulphuric Acid.

Sometimes in thin pearly lamellæ, but usually in a white, crystalline powder, inodorous, taste sweetish and astringent, and acid to test paper. It is permanent in the air, soluble in 1 part of water, and nearly insoluble in alcohol, loses its water of crystallation at about 200°C. and at a red-heat is decomposed, being converted into oxide.

Uses.—In medicine, largely as a **caustic** in the treatment of chronically inflamed surfaces, exuberant growths, etc.

Kaolin.—Kaolinum, U. S.—Chinay Clay.—Native Aluminum Silicate consisting chiefly of the pure Silicate [$H_2Al_2Si_2O_8+H_2O$] powdered and freed from gritty particles by elutriation.

White or yellowish, white powder on in lumps, feeling soft when touched, insoluble in water and in cold dilute solutions of acids and alkalies.

Uses.—As an excipient for pills of Silver Nitrate and for Cataplasm.

Cataplasma Kaolini.—U. S.—A paste or poultice made by mixing Kaolin 57.7 parts, boric acid 4.5 parts, methyl salicylate 0.2, thymol and oil peppermint each 0.05 part and Glycerin to 100 parts.

CERIUM—Ce.

The only compound of this metal of pharmaceutical importance is:

Cerium Oxalate.—Cerii Oxalas, U. S.—A mixture of the oxalates of Cerium, Didymium and Lanthanum and of other rare earths, hence no formula is ascribed to the compound. Prepared from Cerium Chloride by precipitation with Oxalic Acid. The chloride is obtained by the treatment of the mineral gadolenite or cerite in which the metal is usually found, associated with other **rare** Elements, from which it cannot be entirely separated.

The salt is insoluble in both alcohol and water, but soluble in hydrochloric acid.

Uses.—In the powdered form, or as an effervescing granular salt, in nervous affections.

Dose.—0.065 Gm. (1 grain).

CHROMIUM.—Cr.

This element does not occur free in nature but as the mineral Chromite, or Chron-iron ore, $Cr_2O_3.FeO$, from which Potassium Bichromate, the Oxide and the metal are obtained. Potassium Bichromate, the most common compound of Chromium, was described under Potassium.

Chromium Trioxide.—CrO_3.—Chromium Trioxidum, U. S.—Chromic Acid.—Acidum Chromicum, U. S. '90.—Should contain not less than 90 per cent. pure Chromium trioxide (Chromic Acid anhydride).

Obtained from Potassium Bichromate upon addition of Sulphuric Acid to a concentrated solution in water, when upon cooling the crystals separate.

Delicate crimson, needle-like crystals, or strongly lustrous, scarlet, rhombic prisms; strongly deliquescent in moist air, without odor, and intensely caustic when brought in contact with animal tissues. Very soluble in water, forming a deep orange-red solution. If strong alcohol be dropped on the crystals, chemical change takes place with incandescence, the anhydride being reduced to the green sesqui-oxide of chromium. The crystals fuse at 193°C. to a deep-red liquid, and if the temperature be raised to 250°C., decomposition occurs, and the anhydride is reduced to Cr_2O_3, with the evolution of oxygen.

Precautions in handling.—By mixing chromic anhydride with alcohol, ether, **glycerin**, cork, tannin, sugar, or other readily oxidizable substances, rapid combustion, or even **explosion**, may be produced. Owing to its strong affinity for water it must be kept in tightly stoppered bottles.

Uses.—In medicine, chiefly as **caustic**; in microscopy, for hardening tissues.

THE IRON GROUP.

The Iron Group includes the elements Zinc, Manganese, Iron, Nickel and Cobalt.

ZINC.—Zn.

Zinc is a rather abundant metal, though rarely occuring uncombined in nature. Its most important ores are Calamine, or impure Carbonate, zinc blende, franklinite and hydrozincite and they are often found associated with lead ores.

The ores are first roasted to expel sulphur and other impurities, and the oxide thus obtained is heated with charcoal in a suitable furnace. The zinc is distilled over and condensed.

Zincum.—Zn.—A bluish-white metal, which melts at 433°C., is brittle at ordinary temperatures, but between 100°C. and 150° is quite malleable and

ductile. Its sp. gr. is 6.9. When strongly heated in the air, it burns with a bluish flame, and is converted into the oxide.

Pure Zinc is used in pharmaceutical operations in the production of hydrogen gas and for testing. It should be free from **arsenic**. [See U. S. Ph.]

Compounds of Zinc.

These are produced by the action of Acids on the Metal or from the Carbonate or Oxide, prepared from the impure Carbonate. All the Soluble Compounds of Zinc are **poisonous.**

Zinc Chloride.—$ZnCl_2$.—Zinci Chloridum, U. S.—It is produced when pure Zinc is acted upon by pure dilute Hydrochloric Acid.

Pure zinc being expensive, in practice ordinary granular zinc is used, and the iron and other impurities removed by treating the solution with Nitric Acid, evaporating it and heating the dry residue to fusion, to expel the nitric acid, then allowing the mass to cool. The residue thus obtained is treated with Water agitated with Zinc Carbonate, then filtered, and the filtrate evaporated in a porcelain dish, until a drop withdrawn on the end of a glass rod solidifies on cooling to an opaque white solid.

Liquor Zinci Chloridi, U. S., prepared in this way, except that the last filtrate is not evaporated, but is diluted with water so that the solution has the sp. gr. 1.548, and contains about 50 per cent of the dry chloride.

Uses.—Valuable as a **deodorizer** and **disinfectant,** and in injections and washes. As it is very irritant, and in large doses **poisonous,** it must be used with great care.

Zinc Sulphate.—$ZnSO_4+7H_2O$.—Zinci Sulphas, U. S.—Obtained by treating Zinc with Dilute Sulphuric Acid. This is commonly called "White Vitriol."

Large, transparent, rhombic prisms, or in small prisms or prismatic needles, inodorous, taste styptic nauseous, acid to test paper, soluble in 0.53 parts of water in 0.2 part of boiling water, and in 3 parts of glycerin, insoluble in alcohol.

Uses.—Externally for its stimulant and astringent properties, for the preparation of injections, washes, collyria, etc.; internally in nervous diseases; as a prompt **emetic.** In large doses **poisonous.** Also in the preparation of dry Zinc Oleate by chemical decomposition, and many other compounds.

Dose.—As an Emetic 1 Gm. (15 grains).

Precipitated Zinc Carbonate.—Zinci Carbonas Præcipitatus, U. S.—Made by double decomposition of solutions of Zinc Sulphate and Sodium Carbonate. Not a true Carbonate, hence no formula is given for this compound. It should yield not less than 72 per cent. Zinc oxide.

An impalpable, white powder, inodorous, tasteless, permanent in the air, and insoluble in water or alcohol, but soluble in the mineral acids with the evolution of carbon dioxide and in ammonia water.

Uses.—Externally as an astringent and protective to inflamed surfaces.

Preparations.—Unguentum Zinci Carbonatis, an ointment formerly official.

Zinc Oxide.—ZnO.—Zinci Oxidum, U. S.—Made by exposing the Carbonate for some time to a dull red heat, or until a portion of it no longer effervesces with acids (calcination).

Nearly white or slightly yellowish, amorphous, inodorous, tasteless powder, which on heating acquires a lemon-yellow color, insoluble in water or alcohol, but soluble in acids and in ammonia.

Uses.—Rarely internally, but largely as a Dusting Powder for raw and inflamed surfaces; also in the form of ointment.

Dose.—0.25 Gm. (4 grains).

Off, Prep.—Unguentum Zinci Oxidi, 20 per cent with benzoated lard.

Zinc Bromide.—$ZnBr_2$.—Zinci Bromidum, U. S.—Conveniently prepared by treating granulated Zinc with Hydrobromic Acid.

White, granular, very deliquescent powder, with a sharp saline and metallic taste, readily soluble in water and alcohol. Rarely used in pharmacy or in medicine.

Dose.—0.125 Gm. (2 grains).

Zinc Iodide.—ZnI_2.—Zinci Iodidum, U. S.—May be made either by the direct action of Iodine on Zinc in the presence of water, or by that of Hydriodic Acid on the Oxide or Carbonate.

White, granular, crystalline and very deliquescent powder, which is inodorous, with a caustic, metallic taste, and an acid reaction, readily soluble in water, alcohol or ether. When heated with strong sulphuric acid decomposition takes place, and iodine and sulphurous oxide are liberated.

Uses.—Sometimes internally, but more commonly as an external application as a wash for scrofulous sores, etc.

Dose.—0.065 Gm. (1 grain).

Zinc Phosphide.—Zn_3P_2.—Zinci Phosphidum, U. S. 90.—Obtained by fusing Zinc in a crucible, and adding the requisite amount of Phosphorus a little at a time.

Gray crystalline, friable mass, emitting a slight odor of phosphorus, undergoes very slow change in the air, and at a high temperature absorbs oxygen from the air, and is converted into the phosphate. It is insoluble in water or alcohol.

Uses.—In the pill-form in doses of 1 cg. for nervous disorders.

Zinc Acetate.—$Zn(C_2H_3O_2)_2+2H_2O$.—Zinci Acetas, U. S.—Obtained by the reaction of Acetic Acid on Zinc Oxide, or Carbonate.

Thin, white, pearly, six-sided tables or scales, having a faint acetous odor, sharp, metallic taste, and slightly acid reaction. Soluble in 2.5 parts water and 36 parts al ohol.

Uses.—Valuable as an irritant and astringent. Seldom used internally.

Dose.—0.125 Gm. (2 grains).

Zinc Valerate.—$Zn(C_5H_9O_2)_2+2H_2O$.—Zinci Valeras, U. S.—

Obtained by the double decomposition of solutions of Sodium Valerate and Zinc Sulphate.

Soft, white scales of a pearly luster, faint odor of valerian; sweet, and afterward styptic, metallic taste; soluble in 50 parts of water and 35 parts of alcohol; and when heated, first melts and afterward decomposes, leaving zinc oxide.

Uses.—Chiefly in the pill-form, in nervous affections.

Dose.—0.125 Gm. (2 grains).

Zinc Phenolsulphonate.—Zn $(C_6H_5O_4S)_2+8H_2O$.—Zinci Phenolsulphonas.—U. S.—Zinc Sulphocarbotate.—Made by a process similar to that Sodium Phenolsulphonate.

Colorless, transparent crystals which upon exposure to air efflorensce, to light acquire a pinkish tint. Soluble in 1.7 parts of water, in 0.3 parts boiling water and in 0.56 parts boiling alcohol.

Uses.—Externally as **Freckle Lotion** in 1 per cent solution, washes and injections. Internally as an **intestinal antiseptic.**

Dose.—0.125 Gm. (2 grains).

Zinc Stearate.—Zinci Stearas U. S.—An insoluble Soap prepared by double decomposition of Solution of Zinc Acetate and Sodium Stearate.

A fine white powder possessing a greasy feel, insoluble in ordinary solvents.

Uses.—As a **Dusting Powder** and in **Ointments. Unguentum Zinci Stearatis.**—U. S.—50%, with white Petrolatum.

MANGANESE.—Mn.

This element, belonging to the iron group of metals, although represented in a number of common ores, pyrolusite (the **dioxide**), braunite, hausmanite, manganite, and several others, is not nearly so abundant in nature as iron. It is not found in nature in the metallic form, but the metal is extracted from its ores with some difficulty.

Compounds of Manganese.

Manganese Dioxide.—MnO_2.—Mangani Dioxidum, U. S. '90.—Mangani Oxidum Nigrum, U. S. Ph., '80.—Black Oxide of Manganese. A native mineral containing at least 66 per cent of the pure Dioxide.

A heavy, dull black, inodorous, tasteless powder, which is insoluble in water and alcohol. Used as a source of Oxygen; in the manufacture of Chlorine gas, etc. Superceded by the Precipitated Oxide.

Managnese Sulphate.—$MnSO_4+4H_2O$.—Mangani Sulphas, U. S.—Made by the reaction of Sulphuric Acid on the Dioxide.

Transparent, colorless or pale rose-colored crystals, belonging to the right rhombic system. Inodorous, taste bitterish and astringent, slightly efflorescent, soluble in 0.7 parts of water, but insoluble in alcohol. Reaction slightly acid.

Use.—Occasionally as a tonic.

Dose.—0.25 Gm. (4 grains).

Precipitated Manganese Dioxide.—Mangani Dioxidum Precipitatum.—U. S.—Manganese Oxides corresponding to at least 80 per cent Manganese Dioxide (MnO_2). Made by precipitation from a solution of Manganese Sulphate with Ammonia Water and solution of Hydrogen Dioxide, washing and drying the precipitate at 150° C.

A heavy fine black powder insoluble in all liquids.

Uses.—Occasionally as a tonic or oxytocic in pills.

Dose.—0.25 Gm. (4 grains).

Manganese Hypophosphite.—$Mn(PH_2O_2)_2+H_2O$—U. S.—Obtained through interaction of Solutions of Manganese Sulphate and Calcium Hypophosphite.

A pinkish-white crystalline powder, odorless and tasteless, soluble in 6.6 parts water, insoluble in alcohol.

Uses.—In Syrupus Hypophosphitum Compositus.—U. S.

Dose.—0.2 Gm. (3 grains).

IRON AND ITS COMPOUNDS.

IRON.—Fe.

This well-known metal exists native only in meteoric stones, but its Oxides and Carbonates are very abundant, as are also many other of its compounds. The Oxides, which constitute the principal source of the metal, are reduced by carbon at a high temperature, and on this principle depends chiefly the process of "**smelting**" and extracting iron from its ores.

The metal is too familiar a commodity to need particular description here. Iron and its compounds are valuable in medicine for their **tonic** effects, **deepening the color of the red corpuscles**, and, it is supposed, increasing their number.

The **metal** itself is official in two forms:

Iron.—Ferrum, U. S.—In the form of fine, bright, non-elastic wire preferably the form known as **Card-teeth.** It is used in making many of the compounds of iron.

Reduced Iron.—Ferrum Reductum, U. S.—It should contain not less than 90 per cent pure metallic iron.—Made by heating Ferric Hydroxide to redness in an iron tube, and passing a stream of Hydrogen through it. From the process of its preparation also called "Iron by Hydrogen" and **Quevenne's Iron,** after the name of its discoverer.

It is a fine, grayish-black, lusterless powder, attracted by the magnet, without odor or taste, insoluble in water or alcohol, and when ignited in the air, is converted into ferric oxide.

Compounds of Iron.

Iron forms two classes of compounds, viz: **Ferrous** and **ferric** compounds, the element in the former being **bivalent**, in the ferric **trivalent**.

Chemically the two kinds of salts are distinguished as follows:

The **ferrous** salts all have a greenish color and are easily changed to the higher ferric salts through oxidation by exposure to the air and moisture. The alkalies precipitate, from solutions of **ferrous** salts, Ferrous Hydroxide, $Fe(OH)_2$, which through absorption of oxygen loses its greenish-white color and becomes greenish-black then reddish-brown, forming the Ferric Hydroxide, $Fe\ (OH)_3$. From ferric salts the alkalies precipitate the reddish-brown Ferric Hydroxide, $Fe\ (OH)_3$.

Ferrous salts produce with Potassium Ferrocyanide a **dark-blue** precipitate "Turnbull's blue." Ferric salts produce a **deep-blue** precipitate of "Prussian blue."

The two kinds of salts are best distinguished by Potassium Ferricyanide, which produces in **Ferrous** Salts, in dilute solution, a **bluish-white** coloration rapidly changing to a **dark-blue** precipitate; with **Ferric** salts **no** precipitation is produced, but a **deepened brown** color without any green or greenish-blue tinge.

The two classes of compounds are not distinguished in their official Latin titles, all having the same term, Ferrum, genitive Ferri, but in the English titles the distinction is made between the **ferrous** and **ferric** compounds, except in the case of the double scale-salts.

From the metal by direct action of the Acids and Halogens the Chloride, Iodide and Sulphate are made and from these in turn all the other Compounds and Preparations of Iron.

Their strengths are usually based on the percentage amount of **pure metallic iron** contained. This is indicated here by the Symbol Fe and the percentage number: thus Fe-10.=10 per cent metallic iron.

Ferric Chloride.—$FeCl_3+12H_2O$.—Ferri Chloridum, U. S.—(Fe-22.)—Made by the reaction of Hydrochloric Acid on Iron and oxidizing the ferrous chloride so formed into ferric chloride with Nitric Acid. The complete oxidation of the ferrous compound is determined by testing, excess of Nitric Acid removed by heating and the salt allowed to crystallize.

An orange yellow, very **deliquescent** salt, usually in irregular masses of a crystalline fracture, often with a faint odor of hydrochloric acid, a styptic taste, and an acid reaction.

Dose.—0.065 Gm. (1 grain).

Liquor Ferri Chloridi, U. S.—Is prepared in the same way. It contains of the anhydrous chloride 29 per cent in solution of Water, with 5 per cent Hydrochloric Acid; it has the sp. gr. 1.315.

Tinctura Ferri Chloridi, U. S.—35 C.C. of the solution and 65 C.C. alcohol.

Liquor Ferri et Ammonii Acetatis, U. S.—Is prepared from the tincture

chloride of iron 4 parts, solution ammon. acet. 50 p., dil. acetic acid 6 p., elixir, glycerin and water of each to make 100 parts by measure.

Ferric Hypophosphite.—$Fe(PH_2O_2)_3$.—Ferri Hypophosphis, U. S.—Obtained by the double decomposition of Sodium Hypophosphite and Ferric Chloride in aqueous solution.

Grayish or whitish, inodorous, nearly tasteless powder, permanent in the air, but slightly soluble in water, and freely so in hydrochloric acid.

Uses.—In the preparation of Syrupus Hypophosphitum Compositus, U. S.

Iodide of Iron.—FeI_2.—Ferri Iodidum.—Ferrous Iodide.—Made by the reaction of Iodine upon Iron in the presence of Water until the mixture has lost the odor of iodine and acquired a green color, when the ferrous iodide in solution may be obtained by crystallization.

Ferri Iodidum Saccharatum, U. S. '90.—A mixture of Sugar of Milk containing 20 per cent Ferrous Iodide.

Syrupus Ferri Iodidi, U. S.—A solution of Ferrous Iodide in Syrup, containing 5 per cent by weight of ferrous Iodide.

Dose.—1 C.C. (15 minims).

Both of these preparations must be kept in tightly-stoppered vials.

Ferrous Sulphate.—$FeSO_4+7H_2O$.—Ferri Sulphas, U. S.—This is the familiar "Green Vitriol," made by the action of Sulphuric Acid on Iron.

Large, pale bluish-green, efflorescent crystals, in the form of monoclinic prisms, inodorous, with a styptic saline taste and reaction. Soluble in 0.9 parts of water, insoluble in alcohol. Ordinary impure ferrous sulphate is commonly called "**copperas.**"

Ferri Sulphas Exsiccatus, U. S.—Dried Ferrous Sulphate.—Obtained by heating the Sulphate when it loses its water of crystallization and forms a greenish-white powder representing 65 per cent of the weight of the original salt.

Uses.—In Pil. Aloes et Ferri, other unofficial pills and in veterinary practice.

Ferri Sulphas Granulatus, U. S.—Granulated, or "Precipitated," Ferrous Sulphate.—Prepared by concentrating an acidulated aqueous solution of the Sulphate. The salt is obtained as a pale bluish-green crystalline powder which responds to all the tests for the ordinary sulphate.

Uses.—In the preparations of the Carbonate.

Dose.—0.20 Gm. (3 grains).

Ferrous Carbonate.—$FeCO_3$.—Ferri Carbonas.—Obtained by decomposing Ferrous Sulphate with an alkaline Carbonate or Bicarbonate.

Occurs as a white precipitate rapidly changing into the ferric compound and assuming a dark color, upon exposure to the air. Preserved by Sugar added in its **freshly prepared** state, it is official in the following:

Ferri Carbonas Saccharatus, U. S.—A saccharine powder containing 15 per cent.

Massa Ferri Carbonatis, U. S.—Vallet's Mass.—A pill mass containing about 35 per cent.

Mistura Ferri Composita, U. S.—Griffith's Mixture.—A saccharine liquid containing about 2 per cent.

Pilulæ Ferri Carbonatis, U. S.—Blaud's Pill.—Each pill containing about 0.06 of ferrous carbonate.

Ferrous Sulphide.—FeS.—Though not official, is important as being the usual source of Sulphureted Hydrogen. It is made by the direct union of Iron and Sulphur at a high temperature.

Ferric Ammonium Sulphate.—$FeNH_4(SO_4)_2+12H_2O$.—Ferri et Ammonii Sulphas, U. S.—(Fe-11.5).—Ammonio-Ferric Alum.—Made by dissolving Ammonium Sulphate in a hot solution of Tersulphate of Iron and crystallizing.

Transparent octahedral crystals of an amethyst or violet color, efflorescent, inodorous, and of an astringent taste. Soluble in 2.7 parts of water, insoluble in alcohol.

Used in medicine for its astringent properties.

From Ferrous Sulphate two official Solutions are prepared by oxidizing the Sulphate with Nitric Acid in the presence of Sulphuric Acid.

Liquor Ferri Subsulphatis, U. S.—Solution Persulphate of Iron.—Monsell's Solution, containing about 43 per cent of basic ferric sulphate, sp. gr. 1.548.

Liquor Ferri Tersulphatis, U. S.—Solution of Ferric Sulphate, containing 36 per cent normal Ferric Sulphate, sp. gr. 1.420.

From the Solution of Ferric Tersulphate the Ferric Hydrate is prepared and from this, by reaction and solution with their respective acids, the Acetates, Citrates, Phosphates and Tartrates are produced.

Ferric Hydroxide.—$Fe(OH)_3$.—Ferri Hydroxidum.—U. S.—Ferric Hydrate.—Ferri Oxidum Hydratum, U. S. '90.—Made by precipitating a solution of Ferric Sulphate (tersulphate of iron) with Ammonia Water and thoroughly washing the precipitate.

Ferri Hydroxidum cum Magnesii Oxido, U. S.—Arsenic antidote. Is prepared from the Tersulphate Solution by converting the iron into the Hydroxide by treating it with hydrated magnesia.

In its freshly prepared state, this is the best **antidote** to **arsenical** poisoning, and the materials for preparing it should always be kept on hand. [See U. S. Ph.]

Ferric Acetate.—Obtained by reaction of Glacial Acetic Acid on Ferric Hydrate. It is used in the following, formerly official:

Liquor Ferri Acetatis.—This contains 31 per cent of the acetate, sp. gr. 1.160. It should be kept in well-stoppered bottles, away from the light.

Tinctura Ferri Acetatis is made of the solution, 50 parts, alcohol 30 parts, acetic ether 20 parts by measure.

Liquor Ferri Citratis, U. S. '90.—Made by the reaction of

Citric Acid on Ferric Hydroxide and evaporating the solution to the sp. gr., 1.250, when it contains about 35 per cent of the anhydrous salt.

Ferric Citrate.—Ferri Citras, U. S.—(Fe-16)—by evaporating the solution at a temperature not higher than 60°C. to the consistence of syrup, and spreading it on glass plates to dry.

Transparent, garnet-red scales, permanent in the air, odorless, having a very faint, ferruginous taste, and an acid reaction. Slowly but completely soluble in water, insoluble in alcohol.

Dose.—0.25 Gm (4 grains.)

This is the **average dose** of all the scale salts of iron.

Iron and Ammonium Citrate.—Ferri et Ammonii Citras, U. S.—(Fe-16)—Made by mixing 10 parts of the above solution with 4 parts of Ammonia Water, evaporating at a temperature not above 60°C., to a syrupy consistence, spreading it on glass plates and drying.

In the form of deliquescent, garnet-red scales, which must be kept in the dark, or in closely-stoppered bottles.

From this salt the following are made:

Ferri et Strychninæ Citras, U. S.—Contains 1 per cent of Strychnine and 99 per cent of the Citrate of Iron and Ammonium, and is in the form of garnet-red deliquescent scales.

Dose.—0.125 Gm. (2 grains).

Vinum Ferri Citratis, U. S.—Contains 4 per cent of Citrate of Iron and Ammonium.

Iron and Quinine Citrate.—Ferri et Quininæ Citras, U. S.—Fe-13.5)—Quinine 11.5 per cent—made by evaporating a solution containing 85 parts of Ferric Citrate, 12 parts of Quinine and 3 parts Citric Acid, at a temperature not exceeding 60°C., to syrupy consistence, spreading it on plates of glass and drying.

Transparent, yellowish-brown or reddish-brown scales, that are somewhat deliquescent, inodorous, and with a bitter, somewhat ferruginous taste. Must be kept in well-stoppered bottles in a dark place. **Slowly** but completely soluble in cold water, more readily soluble in hot water, and but partially soluble in alcohol. This is the salt used for pills on account of its slow solubility.

Soluble Iron and Quinine Citrate.—Ferri et Quininæ Citras Solubilis, U. S.—(Fe-13.5)—Quinine 11.5 per cent—Made in the same way and of the proportions of the preceding salt, except that Ammonia Water is added to form Ammonium Citrate with the Citric Acid, which increases the solubility of the Quinine Citrate.

Thin, transparent scales of a greenish, golden-yellow color, **rapidly** and completely soluble in cold water, but only partially soluble in alcohol.

Vinum Ferri Amarum, U. S.—Contains 5 per cent of the Soluble Citrate of Iron and Quinine.

Soluble Ferric Phosphate.—Ferri Phosphas Solubilis, U. S.—(Fe-12)—Obtained by treating Citrate of Iron in solution, with Sodium Phosphate, evaporating the solution at a temperature not exceeding 60°C., to syrupy consistence, and drying it on glass plates.

Transparent, bright-green scales, not deliquescent, turning dark on exposure to light and should, therefore, be kept in dark well-stoppered bottles; inodorous, having a somewhat acid taste and reaction, freely soluble in water, and insoluble in alcohol.

Off. Prep.—Glyceritum and Elixir Ferri, Quininæ et Strychninæ Phosphatum.

Soluble Ferric Pyrophosphate.—Ferri Pyrophosphas Solubilis, U. S.—(Fe-10)—Prepared in the same way as the last named salt, except that Sodium Pyrophosphate is used instead of the phosphate.

Resembles the phosphate very closely in its properties, but differs in producing a **white** precipitate instead of a yellow one with solution of silver nitrate.

Uses.—Chiefly in Elixirs, in combination with Cinchona or its alkaloids.

Iron and Ammonium Tartrate.—Ferri et Ammonii Tartras, U. S.—(Fe-13)—Made by dissolving Ferric Hydrate in a solution of Acid Ammonium Tartrate to saturation, evaporating the solution at a temperature not higher than 60°, to syrupy consistence and spreading it on glass plates to dry.

Yellowish-brown, or red, transparent scales, neutral to test paper, inodorous, sweetish and slightly ferruginous to the taste, and only slightly deliquescent. Soluble in water, but almost insoluble in alcohol and ether. Should be kept in well-stoppered bottles in a dark place.

The Tartrates are **insoluble** in Tinctures made with Diluted Alcohol.

Iron and Potassium Tartrate.—Ferri et Potassii Tartras, U. S.—(Fe-10)—

The process of manufacture is analogous to that of the preparation just described, Potassium Bitartrate being used instead of ammonium bitartrate; the salts also resemble each other in their properties and uses.

Ferrous Oxalate.—$FeC_2O_4+H_2O$.—Ferri Oxalas. Not official.—Obtained by treating a solution of Ferrous Sulphate with the proper proportion of Oxalic Acid.

A yellowish, crystalline precipitate, inodorous and nearly tasteless, permanent in the air, but slightly soluble in water, at 155°C. loses its water of crystallization, and at a higher temperature is decomposed, leaving ferric oxide.

Ferric Valerianate.—Ferri Valerianas, U. S., '90.—Made by adding to a cold solution of either Ferric Chloride or Ferric Sulphate a cold solution of Sodium Valerianate so long as a precipitate is produced.

A brick-red, amorphous powder with a slight odor and taste of valerianic acid. It is decomposed by boiling water, leaving ferric hydrate.

Uses.—Similar to other valerianates; dose, 0.1 Gm.

Ferrous Lactate.—$Fe(C_3H_5O_3)_2+3H_2O$.—Ferri Lactas, U. S., '90.—Made by the direct action of Lactic Acid on Iron.

Greenish-white, crystalline crusts or grains, not deliquescent, inodorous, with a sweetish, ferruginous taste and a slightly acid reaction. Slowly but completely soluble in 40 parts of water, in 12 parts of boiling water; almost insoluble in alcohol.

Uses.—In the preparation of Syrups of Hypophosphites and Elixirs.

Lead—Pb.

Lead is sometimes, but not often, found free in nature, but its ores are rather abundant, the most important being the Sulphide **(galena)** and the Carbonate (cerussite.)

There are a variety of ways of obtaining it, depending on the character and purity of the ores. From a pure form of galena it is obtained by roasting it in a reverberating furnace, when a part of the ore is reduced and a part converted into the sulphate, and then, by afterward raising the temperature, the sulphate is also decomposed. In inferior ores carbon is used in the process.

Plumbum.—Pb.—A soft metal, with a metallic lustre and a blue-gray color; very ductile and malleable, but not very tenacious; quite soft; sp. gr. 11.4; melts at 325°C., and volatilizes at a white heat. The metal itself is not of importance in pharmacy.

The soluble compounds of Lead are all **poisonous,** the best antidote being Magnesium Sulphate 15 Gm. dissolved in a glassful of water. **Vomiting** should be promoted by hot water or mustard and milk or demulcent drinks should be administered to allay irritation.

Lead Oxide.—PbO.—Plumbi Oxidum, U. S.—Litharge.—Can be made by heating metallic Lead strongly in Air, but is chiefly obtained as a by-product in the extraction of silver from its ore.

A heavy powder, varying in color from yellowish to reddish, permanent in air, odorless, tasteless, insoluble in water and alcohol, and by means of the blow-pipe and charcoal, readily reducible to metallic lead.

Uses.—In preparing various Salts of lead; formerly in Lead Plaster and Ointments.

Off. Prep.—Liquor Plumbi Subacetatis.

Red Lead is a mixture of different oxides of lead, is of a bright-red color and should not be confounded with the above in preparing **Emplastrum Fuscum,** N. F.

Lead Acetate.—$Pb(C_2H_3O_2)_2+3H_2O$.—Plumbi Acetas, U. S.—Sugar of Lead.—Obtained by treating the Oxide with Acetic Acid.

Colorless, transparent or translucent prisms or tables, efflorescent, and slowly converted into carbonate on exposure to the air, with a faintly

acetous odor, and a sweet, astringent and metallic taste, soluble in 2 parts of water and in 30 parts achohol. The commercial salt should be purified by **recrystallization** for medicinal use.

Uses.—In preparing **Emplastrum Plumbi**; as an astringent in washes and injections; internally in the pill form, and in chemistry as a precipitant of various organic principles; also with Sulphur in **Hair Restorers.**

Dose.—0.065 Gm. (1 grain).

Subacetate of Lead Solution.—Liquor Plumbi Subacetatis U. S.—Sometimes called Goulard's Extract. Made by boiling a solution of Lead Acetate in Distilled Water with Lead Oxide (litharge) until no more oxide is dissolved, or it is converted into Subacetate. The water lost by evaporation is replaced constantly by Distilled Water, so that the filtered liquid shall have the sp. gr. 1.235 and contain 25 per cent of the salt.

The subacetate of lead in this solution is not a definite compound, but a mixture of Oxyacetates. Upon exposure it absorbs carbonic acid from the atmosphere and is converted into insoluble carbonate. Distilled water is therefore directed to be used in the preparation of the dilute solution or "**lead water,**" as well as in the concentrated solution. It should be preserved in small, tightly-stoppered bottles.

Uses.—Only externally as an astringent and sedative and in the following official preparations:

Liquor Plumbi Subacetatis Dilutus, U. S.—Containing 4 parts of the above Solution in 100 parts of Distilled Water.

Ceratum Plumbi Subacetatis, U. S.—Prepared by mixing 20 parts of the Solution with Lanolin 20, Paraffin 20, and Petroleum 38, in which 2 parts Camphor is dissolved.

Also in the unofficial **Liniment** made by mixing 40 parts of concentrated Solution of Lead Subacetate with 60 parts of Cotton Seed Oil.

Lead Carbonate.—$(PbCO_3)_2Pb(OH)_2$.—Plumbi Carbonas, U. S., '90.—White Lead.—Obtained by the reaction of Carbonic Acid on the Acetate by exposure to the air, "**corroding.**"

Heavy, white powder, odorless, tasteless, permanent in the air, and insoluble in water and alcohol. When heated strongly, it changes to yellow, losing carbon dioxide and being converted into the oxide. A finer quality used for cosmetic purposes is sold as "Flake White."

Uses.—Externally as a protective to irritated surfaces, but owing to its poisonous character it cannot safely be applied except to the unbroken skin. It is largely used in the arts, ground in oil, as paints and Unguentum Plumbi Carbonatis, 20 per cent; formerly official.

Lead Nitrate.—$Pb(NO_3)_2$.—Plumbi Nitras, U. S.—Made usually by treating Litharge, or the Carbonate with Dilute Nitric Acid.

Colorless, transparent or nearly opaque octahedra, sp. gr. 4.4, permanent in air, and soluble in 1.85 parts of water, and nearly insoluble in alcohol.

Uses.—In preparing the Iodide, and to a limited extent in medicine as a discutient and as a deodorizing agent.

Lead Iodide.—PbI_2.—Plumbi Iodidum, U. S.—Obtained by interaction of solutions of Lead Nitrate and Potassium Iodide.

The precipitate obtained is a bright yellow powder, inodorous, of a somewhat metallic taste, turns brick-red when heated, and if in contact with the air, gives off iodine and is converted into oxyiodide, which is citron-yellow in color. Almost insoluble in alcohol or water.

Uses.—Chiefly externally in ointment.

Unguentum Plumbi Iodidi, 10 per cent; formerly official.

COPPER—Cu.

This metal occurs in considerable abundance, both native and combined. Its most importat ores are the Black Oxide or melanconite, the Red Oxide, malachite, azurite, chalcocite or copper glance, and chalcopyrite or copper **pyrites.**

The methods of extracting the copper differ, according to the nature of the ores.

Cuprum.—Cu.—A red metal, with a bright, metallic lustre, very tough, malleable and ductile, has a sp. gr. of 8.94, is next to silver in its **conductivity** of heat and electricity, and fuses at a bright-red heat. It forms two oxides: Red oxide and black oxide of copper.

Copper Sulphate.—$CuSO_4+5H_2O$.—Cupri Sulphas, U. S.—Blue Vitriol.—Obtained by oxidizing the Sulphide or by the action of Dilute Sulphuric Acid on the Metal. This is the most common salt of Copper and from it all other compounds are made.

Large, deep-blue, translucent, triclinic crystals, which on exposure to the air effloresce. They have an acid reaction, are without odor, and have a disagreeable metallic taste. Soluble in 2.2 parts of water and almost insoluble in alcohol (400 parts). Converted by a temperature a little above 230°C into the anhydrous salt, and at a red-heat decomposed.

Uses.—Chiefly in Collyria, Injections, Lotions, and occasionally as an **emetic,** or in smaller doses as a tonic and astringent. As a reagent in various Test Solutions and in **Fehling's Solution.** [See U. S. Ph.]

Dose.—Astringent, 0.01 Gm. (1-5 grain); Emetic, 0.25 Gm. (4 grains).

Cuprum Ammoniatum.—Made by rubbing together in a mortar, until effervescence ceases, Copper Sulphate 4 parts, Ammonium Carbonate 3 parts, and drying the resulting mass on bibulous paper at a gentle heat. Used as a Test Solution and also for coloring show-liquids. Not official.

Copper Acetate.—$Cu(C_2H_3O_2)_2+H_2O$.—Cupri Acetas, Verdigris.—It is variously prepared, but may be obtained by mixing solutions of Lead Acetate and Copper Sulphate, when Lead Sulphate will be precipitated and Copper Acetate remain in solution. It is not official.

Deep blue-green, rhombic prisms, opaque or translucent, efflorescent, odorless, taste disagreeable, metallic, and with an acid reaction.

Uses.—Chiefly in Collyria, Lotions, and as an ingredient in corn remedies.

Tinctura Cupri Acetici.—Rademacher. Prepared by digesting 90 parts Copper Sulphate and 112.5 parts Lead Acetate with 510 parts water, boiling the mixture, adding when cold 390 parts alcohol and after frequent agitation for 4 days, filtration of the solution.

The Salts of Copper are not very poisonous, but its double compound with arsenic, the aceto-arsenite of copper, or "Paris Green," is exceedingly **poisonous.**

TIN—Sn.

This metal is rarely found native. Its principal ore is cassiterite, or tinstone, SnO_2, but it also exists in the form of tin pyrites, which is a compound of copper, zinc, iron and tin with Sulphur; in the form of silicate, and in small proportion in several complex minerals.

It is obtained from Tinstone by levigation and elutriation, roasting to oxidize sulphides that may be present, again elutriating to get rid of lighter oxides that may be present; and then reduction of the purified tin oxide thus produced, in a suitable furnace with coal.

Stannum.—Sn.—Brilliantly lustrous, white metal, melting at 235°C., volatilizing at a white heat, sp. gr. 7.293, exhibits a fibrous fracture, when bent produces a crackling sound, is somewhat harder than lead, malleable and ductile, but not very tenacious.

As tin is not readily oxidized in moist air, it is highly valuable for tinning, coating iron and copper surfaces, which is its principal use in the arts.

All compounds and preparations of tin are **poisonous.**

Tin Chloride.—$SnCl_2 2H_2O$.—Stannous Chloride.—Obtained by dissolving Tin in hot Hydrochloric Acid, is used as a **reagent,** and largely in the arts and manufactures.

GOLD—Au.

The only Compound of Gold used in medicine is:

Gold and Sodium Chloride.—$AuCl_3NaCl$.—Auri et Sodii Chloridum, U. S.—"Double Chloride of Gold and Sodium." A mixture of equal weights of Gold Chloride and Sodium Chloride, representing 30 per cent of Gold. Obtained by dissolving Gold in Nitrohydrochloric Acid, adding Sodium Chloride and evaporating the solution to dryness.

An orange-yellow powder, very deliquescent, and soluble in water.

Used as a tonic in dipsomania, etc.

Dose.—0.005 Gm. (1-10 grain).

CADMIUM—Cd.

Cadmium Bromide, though an unofficial salt, is sometimes used in pharmacy. It is prepared by double decomposition of solutions of cadmium sulphate and potassium bromide.

SILVER—Ag.

Silver occurs both free and in combination. Its most important ores are silver glance (Ag_2S), ruby silver (Ag_3SbS_3), silver-copper glance ($(AgCu)_2S$), and horn silver ($AgCl$). It is

obtained from the ores by processes which differ considerably, according to the nature of the ores, their purity, etc.

Argentum.—Ag.—A bright, white metal, susceptible of a high degree of polish, the best **conductor** of heat and electricity, tenacious, malleable, and very ductile, fuses at 1040°C., and volatilizes at a white heat. Its specific gravity is about 10.5.

Uses.—In pharmacy in the preparation of silver compounds. Its **surgical** uses are also numerous, because it is not readily oxidized.

Silver Compounds.

Silver Nitrate.—$AgNO_3$.—Argenti Nitras, U. S.—Obtained by treating Silver with dilute Nitric Acid. This is the most important salt of silver, and from it all the other compounds are produced.

Colorless, transparent, tabular, rhombic crystals, odorless, very caustic and bitter taste, and of neutral reaction. Soluble in 0.54 parts of water, in 24 parts of alcohol, and in 5 parts boiling alcohol. The crystals and aqueous solution are permanent and not affected by light, but when **exposed to the air** become rapidly dark in color, owing to decomposition induced by contact with organic matter.

Uses.—In medicine chiefly as a local remedy, either in solution, as a wash, or in substance moulded into sticks (lunar caustic) for **cauterization.** Internally in the **pill-form,** the mass being made with an excipient of indifferent character to prevent reduction of the salt, such as **Kaolin** and **Petrolatum.** It is used largely as a **Hair Dye,** and for **Indelible Ink,** owing to its property of leaving a permanent black stain upon organic matter. Stains upon the skin may be removed by a solution of potassium cyanide. Taken internally in large doses it is **poisonous,** sodium chloride being the proper **antidote.**

Dose.—0.01 Gm. (1-5 grain).

From nitrate of silver are prepared the following:

Argenti Nitras Mitigatus, U. S.—Argenti Nitras Dilutus, U. S., '90.—"Mitigated Caustic."—Contains 33 per cent Silver Nitrate. Prepared by fusing together one part of Silver Nitrate and two parts Potassium Nitrate, and casting into cones or cylindrical sticks.

Argenti Nitras Fusus, U. S.—Lunar Caustic.—"Lapis Infernalis."—Made by fusing the Nitrate and adding a little Hydrochloric Acid to the melted mass, which is then cast into sticks. The small amount of Silver Chloride (5 per cent) contained in this form of the salt makes it tough and the sticks less friable.

Silver Oxide.—Ag_2O.—Argenti Oxidum, U. S.—Obtained by interaction of solutions of Silver Nitrate and solutions of Lime of Caustic Potash.

Inodorous, brownish or blackish powder, undergoing reduction or partial reduction on exposure to light; its uses are similar to those of the nitrate. It should **not be triturated** with readily oxidizable or combustible substances, nor brought in contact with Ammonia.

Dose.—0.065 Gm. (1 grain).

Silver Cyanide.—AgCN.—Argenti Cyanidum, U. S.—Made by conducting a stream of Hydrocyanic Acid, distilled from a mixture of Potassium Ferrocyanide and Sulphuric Acid, into a solution of Silver Nitrate, and washing and drying the precipitate.

White, amorphous powder, permanent in dry air, but slowly growing brown by exposure to the light. It is without odor and taste, and not soluble either in alcohol or water; exceedingly **poisonous.**

Off. Prep.—Acidum Hydrocyanicum Dilutum.

Silver Iodide.—AgI.—Argenti Iodidum, U. S.—By interaction of solutions of Silver Nitrate and Potassium Iodide.

An amorphous light-yellow and heavy powder that is inodorous, tasteless, and insoluble in tne ordinary solvents.

Its medicinal use is limited.

MERCURY—Hg.

This is the only metal that is liquid at ordinary temperature. It is sometimes found free in nature in minute globules, but is usually obtained from its ores, the chief of which is **Cinnabar,** an impure Sulphide of Mercury. The metal is obtained by roasting the ores in a suitable furnace. The sulphur burns and the mercury volatilizes and is collected in a cooling chamber to which the vapors are conducted.

Mercury.—Hydrargyrum, U. S.—Quicksilver.—A silvery, mobile liquid, having a sp. gr. of 13.535, solidifying at —39°C., and boiling at 357.2°C. It forms two series of salts, the **mercurous** and **mercuric.**

Preparations of Mercury.

Mercury in all its forms is active, and in its more soluble forms highly **poisonous.** It acts powerfully on the glandular system, and is useful in many cases, both of local and general inflammation. The metal itself, in the liquid form, is not often medicinally employed, but by triturating it for a long time with fats, chalk or sulphur, it is mechanically reduced to a **fine state of division,** and in this form possesses more active properties, and has important medicinal uses. The following preparations contain mercury in the **metallic form:**

Mass of Mercury.—Massa Hydrargyri, U. S.—Blue Mass.—Contains one-third its weight of Mercury made into a mass with Licorice, Althea, and Honey of Rose, with the addition of 3 per cent of Glycerin to keep it soft.

Dose.—0.25 Gm. (4 grains).

Hydrargyrum cum Creta, U. S.—Mercury with Chalk.—Contains 38 per cent of Mercury, triturated with Honey and Prepared Chalk, until so finely divided that no globules of mercury are visible with a lens magnifying no less than 4 diameters.

Dose.—Same as the Mass.

Unguentum Hydrargyri, U. S.—Mercurial Ointment.—Containing one-half its weight of Mercury. The Mercury is extinguished with a little Mercury Oleate and incorporated with Lard and Suet.

Unguentum Hydrargyri Dilutum, U. S.—Blue Ointment.—A mixture of two parts Mercurial Ointment and one part Petrolatum. Contains 33 per cent Mercury.

Emplastrum Hydrargyri, U. S.—Mercurial Plaster.—Containing 30 per cent of Mercury with Lead Plaster and Lanolin.

Emplastrum Ammoniaci cum Hydrargyro, U. S., '90.—Ammoniac Plaster with Mercury.—Containing 18 per cent of Mercury with Ammoniac and Lead Plaster.

Compounds of Mercury.

Mercury is **bivalent** and forms two classes of salts, i. e., mercurous and mercuric compounds.

The Mercuric Chloride, Sulphate, and Cyanide are the only compounds sparingly soluble in water and more freely soluble in alcohol, as is also the Iodide. The **Mercurous** compounds are almost **insoluble** in either water, or alcohol.

The two classes of compounds are distinguished by the following reactions:

Hydrochloric Acid with mercurous salts **white** precipitate; with mercuric no precipitate.

Potassium Iodide with mercurous salts **greenish-yellow** precipitate; with mercuric, yellow precipitate turning scarlet.

Ammonia Water with mercurous salts, **black** precipitate, with mercuric a **white** precipitate.

Compounds of mercury are more or less affected by light and should be protected against it by being kept in **dark-colored** bottles.

Mercury forms with Sulphur five compounds: Red Mercuric Sulphide, HgS, found native, and from which mercury is chiefly derived; also Black Sulphide of the same composition; Mercuric Sulphate, $HgSO_4$, by reaction of sulphuric acid on the metal; Yellow Mercuric Subsulphate, $Hg(HgO)_2SO_4$, by decomposition of the mercuric sulphate in boiling water, and Mercurous Sulphate, Hg_2SO_4, made by direct union of the metal with mercuric sulphate, or with sulphur.

Red Mercuric Sulphide.—HgS.—Hydrargyri Sulphidum Rubrum.—Commonly known as Cinnabar.—Occurs native, and in that form constitutes one of the principal ores of mercury. It is also made by heating together Mercury and Sulphur, and subliming the mixture.

In the form of brilliant dark red masses, having a crystalline structure, or else a bright scarlet powder; inodorous, tasteless, permanent in the air; insoluble in water or alcohol; it turns dark on heating, but resumes its normal hue again on cooling. The pure sulphide, used in the arts as

Vermilion, is completely volatilized by heat, which is not true of samples adulterated with red lead, or with basic lead chromate. Seldom used medicinally.

Black Mercuric Sulphide, or "Ethiop's Mineral," has the same composition, and is made by fusing together equal parts of sulphur and mercury.

Yellow Mercuric Subsulphate.—$Hg(HgO)_2SO_4$.—Hydrargyri Subsulphas Flavus, U. S., '90.—"Turpeth Mineral."—The normal sulphate added to boiling distilled water and heated, upon cooling of the mixture precipitates, is washed and dried.

Heavy, bright lemon-yellow powder, unchangeable in the air, odorless, slight metallic taste, sp. gr. 6.44, very slightly soluble in cold water, insoluble in alcohol, and when heated turning red, but resuming its original color on cooling. It is a powerful irritant poison. But little used medicinally.

Mild Mercurous Chloride.—$HgCl$.—Hydrargyrum Chloridum Mite, U. S.—Calomel.—Mild Chloride of Mercury.

Obtained by the double decomposition of Mercurous Sulphate and Sodium Chloride. Mercurous Sulphate mixed with Sodium Chloride in a suitable retort is subjected to heat: $Hg_2SO_4 + 2NaCl = 2HgCl + Na_2SO_4$. The calomel sublimes, is collected in a cool chamber, washed with water to free it from the soluble mercuric chloride, and then dried.

A white impalpable powder, showing small isolated crystals under the microscope, assuming a yellowish coloration upon trituration, and becoming grayish upon exposure to light. Insoluble in neutral solvents, but decomposed by strong acids and colored black by ammonia water. It should be kept in dark amber-colored bottles.

Caution.—In contact with the chlorides of ammonium, potassium and sodium, it becomes more soluble and therefore more active, and great care should be observed in dispensing calomel with these substances.

Uses.—In medicine as a cathartic, and externally as a wash combined with lime water—Lotio Nigra, N. F.

Off. Prep.—Pilulæ Catharticæ composita; also in unofficial Pills; Pil Antimoni Comp.

Dose.—Laxative, 0.125 Gm. (2 grains); Alterative, 0.065 Gm. (1 grain).

Corrosive Mercuric Chloride.—$HgCl_2$.—Hydrargyri Chloridum Corrosivum, U. S.—Corrosive Chloride, or Bichloride of Mercury.—Corrosive Sublimate.—Made by the double decomposition of Mercuric Sulphate and Sodium Chloride, heating the mixture and obtaining the mercuric chloride by sublimation.

Heavy white crystalline masses, or colorless rhombic prisms. Sp. gr. 5.4, fuses at 265°C. and at 300°C. sublimes without residue. Permanent in air, inodorous (but its dust very irritating), with an acrid metallic taste, soluble in 13 parts of water, in 3 parts of alcohol, in 4 parts of ether and in 14

parts of glycerin. It is a powerful irritant poison. **Antidote:** White of egg or milk.

Uses.—In making many mercury compounds in medicine, as an alterative and externally as an antiseptic. It is the most powerful of all known antiseptics, but owing to its poisonous properties it must be used only with great care. With potassium iodide it forms a double compound, a solution of it being a valuable reagent for the alkaloids (**Mayer's Solution**). With Lime Water it forms a yellow mixture, **Lotio Flava,** "Yellow Wash," N. F.

Dose.—0.003 Gm. (1-20 grain).

Yellow Mercuric Oxide.—HgO.—Hydrargyri Oxidum Flavum, U. S.—Obtained by interaction of solutions of Mercuric Chloride and Soda, and collecting, thoroughly washing and drying the precipitate.

A light orange-yellow, amorphous, heavy impalpable powder, permanent in the air, but becoming darker on exposure, and should, therefore, be protected from the light, odorless, tasteless, insoluble in water and alcohol, and changing to red when strongly heated.

Off. Prep.—Oleatum Hydrargyri; Ung. Hydrargyri Oxidi Flava.

Yellow Mercurous Iodide.—HgI.—Hydrargyri Iodidum Flavum, U. S.—Hydrargyrum Iodidum Viride.—Protiodide, Yellow, or Green Iodide of Mercury.—Obtained by precipitating an acid Solution of Mercurous Nitrate with Potassium Iodide, thoroughly washing and drying the precipitation formed.

A bright yellow amorphous powder, odorless and tasteless, which becomes darker colored on exposure to the light, without odor or taste, insoluble in alcohol, and nearly so in water. It is less poisonous than the red iodide.

Uses.—Chiefly in treatment of syphilis in the **pill-form,** in **dose** of 0.010 Gm. (1-5 grain).

Red Mercuric Iodide.—HgI_2.—Hydrargyri Iodidum Rubrum, U. S.—Biniodide of Mercury.—Obtained by the reaction of Potassium Iodide and Mercuric Chloride in solution.

Scarlet red, crystalline powder, without color or taste, permanent in air, nearly insoluble in water and soluble in 116 parts of alcohol, and in 15 parts of boiling alcohol; also soluble in solutions of potass. iodide or mercuric chloride. A powerful irritant poison.

Uses.—Occasionally given in syphilis, either alone in the **pill-form,** or in solution in conjunction with potassium iodide.

Dose.—0.003 Gm. (1-30 grain).

Off. Prep.—Liquor Areseni et Hydrargyri Iodidi.

Ammoniated Mercury.—$HgNH_2Cl$.—Hydrargyrum Ammoniatum, U. S.—Hg-78-80. White Precipitate.—Obtained by decomposing a solution of Mercuric Chloride with Ammonia Water in excess a white precipitate of mercuric ammonium chloride being formed:

$HgCl_2+2NH_4OH=HgNH_2Cl+NH_4Cl+2H_2O.$

This, after being washed, is dried between sheets of filter paper at a gentle heat.

It is used only in the form of ointment.

Unguentum Hydrargyri Ammoniati, U. S.—Strength 10 parts to 90 of Benzoinated Lard.

Mercuric Nitrate.—$Hg(NO_2O)_2$.—Hydrargyri Nitras.—Made by dissolving metallic Mercury in Nitric Acid. It is official in the following forms:

Liquor Hydrargyri Nitratis, U. S.—Containing 60 per cent by weight of Mercuric Nitrate with some free nitric acid; sp. gr. of the solution 2.086.

Unguentum Hydrargyri Nitratis, U. S.—Citrine Ointment.—Prepared by mixing a solution of Mercuric Nitrate with Lard previously acted upon by nitric acid in order to prevent the decomposition of the mercuric nitrate.

Red Mercuric Oxide.—HgO.—Hydrargyri Oxidum Rubrum, U. S.—Red Precipitate. Usually obtained by decomposing Mercuric Nitrate by means of heat.

Crystalline, red or orange-red, heavy powder, or scales, permanent in air, odorless, tasteless, insoluble in water and alcohol. It turns darker when heated, and at a high temperature evolves oxygen and is reduced to the metallic state.

Off. Prep.—Unguentum Hydrargyri Oxidi Rubri, 10 per cent.

It will be observed there is no chemical difference between the Yellow and Red Oxides, both being **Mercuric** compounds. The difference in color is due to a variation in the arrangement of the molecules derived from the different methods of producing the two oxides.

Mercuric Cyanide.—$Hg(CN)_2$.—Hydrargyri Cyanidum, U. S., '90.—Obtained by dissolving Mercuric Oxide in Hydrocyanic Acid, produced by treating Potassium Ferrocyanide with Sulphuric Acid.

Colorless, or white quadrangular prisms, permanent in air, inodorous, bitter, metallic taste, if kept from the light, permanent in the air, and soluble in 12.8 parts of water and 15 parts of alcohol. It is very **poisonous.**

Uses.—Similar to mercuric chloride, but a dangerous and little used remedy.

ANTIMONY—Sb.

This metal rarely occurs in the native state. Its most common ore is stibnite, Sb_2S_3, but many others are known, as a compound of iron, antimony and sulphur; of copper, antimony and sulphur; and a compound of lead, antimony and sulphur, etc.

Stibium.—Sb.—Lustrous, silver-white metal, of a crystalline structure, and at ordinary temperature brittle; fuses at 425°C., volatilizes at a red heat, and at the temperature of its melting point readily oxidizes in the air, but remains unchanged at ordinary temperatures. Its sp. gr. is about 6.86.

The Solution of the Chloride, known as **Butter of Antimony,** is used extensively in the arts.

The Tartrate of Antimony and Potassium is the only Antimony compound official.

The most common compound is the Sulphide from which the other sulphur compounds of Antimony are made.

Antimony Sulphide.—Sb_2S_3.—Antimonii Sulphidum, U. S., '90.—The mineral stibnite is freed from the impurities, with which the native mineral is usually associated, by fusion, the impurities mostly remaining behind, while the fused Sulphide is poured off.

In masses of a steel-gray color, more or less striated, and of a metallic lustre, forming, when pulverized, a dull grayish powder, which is insoluble in alcohol or water, and without odor or taste. It may be distinguished from black oxide of manganese, which it outwardly resembles, by its ready fusibility.

Uses.—It is seldom used in medicine, but constitutes the chief source of the metal and of the various compounds of antimony.

Purified Antimony Sulphide.—Antimonii Sulphidum Purificatum, U. S., '90.—The finely powdered sulphide is freed from coarse particles by elutriation and macerated for five days in Ammonia Water, which dissolves the arsenic. The powder, after being washed, is finally dried.

A heavy grayish-black powder, insoluble in water or alcohol.

Its chief use is in the preparation of the following:

Sulphurated Antimony.—Antimonium Sulphuratum, U. S., '90.—"Kermes Mineral:"—Consists chiefly of Antimonious Sulphide mixed with a small amount of Antimonious Oxide. Obtained by dissolving the purified sulphide in an aqueous solution of one of the Fixed Alkalies, and then precipitating it by means of Dilute Sulphuric Acid.

An amorphous, reddish-brown powder, inodorous, tasteless, and insoluble both in water and alcohol. When heated with hydrochloric acid it is nearly all dissolved with the evolution of hydrogen sulphide.

Uses.—It is not much used at present in medicine, but has the essential properties of other antimony compounds; in Pilulæ Antimonii compositæ formerly official.

Antimony Oxide.—Sb_2O_3.—Antimonii Oxidum, U. S., '90.—Exists in nature as the mineral cervatite, but it is usually prepared for medicinal use from the Chloride by precipitation in water.

A heavy grayish-white powder, but slightly soluble in water, and insoluble in alcohol. Soluble in hydrochloric and tartaric acids, and in hot solution of potassium bitartrate. When heated to a bright red heat it sublimes and forms crystals called flowers of antimony.

Uses.—In the preparation of Tartar Emetic, and occasionally in medicine as a nauseant, sudorific or emetic, as in Pulvis Antimonialis, formerly official.

Antimony and Potassium Tartrate.—$2K(SbO)C_4H_4O_6+H_2O$.—Antimonii et Potassii Tartras, U. S.—Tartar Emetic.—Made by the action of Acid Tartrate of Potassium on Oxide of Antimony, in the presence of Water.

Colorless, transparent crystals of small size, in the form of rhombic octahedra which, on exposure to the air, become white and opaque, are inodorous, have a sweetish, followed by a disagreeable, metallic taste. Soluble in

15.5 parts water, in 3 parts of boiling water, insoluble in alcohol, which precipitates it from aqueous solution as a fine crystalline powder.

Uses.—As a test; in preparing compounds, and in medicine as an **emetic** and irritant. As an **antidote** tannin should be given.

Dose.—Expectorant, 0.005 Gm. (1-10 grain); Emetic, 0.030 Gm. (½ grain).

Off. Prep.—Syrupus Scillæ compositus; Vinum Antimonii.

BISMUTH—Bi.

Bismuth exists in the metallic state in some localities. The commercial supply is chiefly derived from the mines in Saxony, where it occurs associated with silver, cobalt, and nickel. It also exists as the oxide and sulphide, and in other combinations. It is readily separated from the metals, with which it is alloyed, by taking advantage of its comparatively low fusing-point.

Bismuthum.—Bi.—Hard, brittle, bright, metallic luster, crystalline structure, grayish, with a reddish tinge, sp. gr. 9.823, melts at 270°C., and expands in solidifying. The metal itself is not used in medicine, but is used for **type-metal,** as is Antimony.

Compounds of Bismuth.

Bismuth Subnitrate.—Bismuthi Subnitras, U. S.—Should yield not less than 80 per cent Bismuth oxide.—Obtained by dissolving the metal in Nitric Acid, pouring the concentrated solution into Ammonia Water, redissolving the precipitated hydroxide in Nitric Acid and again precipitating with a solution of Sodium Carbonate; the Subcarbonate so formed is again dissolved in Nitric Acid and the solution poured into Ammoniated water, the Subnitrate precipitates, is washed and dried.

Heavy, white powder of somewhat varying chemical composition permanent in the air, odorless, tasteless, and insoluble in water and alcohol. At a red heat it, like the subcarbonate, is converted into yellow bismuthous oxide.

Uses.—Internally, either alone or in conjunction with pepsin, in disorders of the stomach and alimentary canal, where, owing to its **insolubility,** it protects inflamed surfaces. Externally as **injection** and **ointment,** and popularly as a **snuff** in catarrh.

Also for preparing Citrate of Bitmuth, and several unofficial compounds.

Bismuth Citrate.—$BiC_6H_5O_7$.—Bismuthi Citras, U. S.—Should yield 58-60 per cent Bismuth Oxide.—Obtained by boiling the Subnitrate, in a solution of Citric Acid.

White, amorphous powder, permanent in the air, odorless, tasteless, insoluble in water and alcohol, but soluble in water of ammonia, citrates and alkalies.

Uses.—Similar to subnitrate and subcarbonate, and to prepare the citrate of bismuth and ammonia.

Bismuth and Ammonium Citrate.—Bismuth et Ammonii Citras, U. S.—Should yield not less than 48 per cent Bismuth Oxide.—Made by dissolving Bismuth Citrate in weak Ammonia-Water, filtering and evaporating the liquid to a syrupy consistence, spreading upon glass-plate and drying so as to obtain the salt in scales.

Pearly or nearly transparent scales, becoming opaque on exposure to the air, of neutral or faintly alkaline reaction, very soluble in water, but sparingly in alcohol. The salt loses ammonia if not carefully protected from the air, and becomes insoluble in water, but when the liquid is rendered **slightly alkaline** by addition of ammonia-water, it becomes again easily soluble.

Uses.—In many **Elixirs** associated with iron, quinine, hydrastine, strychnine, pepsin, etc. With pepsin, which requires an acid solvent, the sodio-bismuth tartrate has been employed, instead of the ammonio-citrate of bismuth, the latter being precipitated in acidulated solutions.

Liquor Bismuth.—N. F.—Contains two grains of the ammonio-citrate in one fluid drachm.

Bismuth Subcarbonate.—Bismuthi Subcarbonas, U. S.—Should yield not less than 90 per cent Bismuth Oxide.—Obtained by dissolving Metallic Bismuth in Nitric Acid, pouring the solution into Ammonia Water, dissolving the washed precipitate in Nitric Acid and pouring the solution of the Nitrate thus formed into a solution of Sodium Carbonate, similarly to the first steps in the process for making the Subnitrate, collecting and thoroughly washing and drying the precipitate.

Whitish, or slightly yellowish, amorphous powder, of somewhat varying chemical composition, unchangeable in the air, inodorous, tasteless, insoluble in water and alcohol, and at a red heat is converted into yellow bismuth oxide.

Uses.—Same as subnitrate, which see.

Bismuth Subgallate.—Bismuthi Subgallas.—U. S.—Should yield 52-57 per cent Bismuth Oxide.—By interaction of Gallic Acid and a solution of a Bismuth Salt.

A bright yellow, amorphous powder, insoluble in all neutral liquids.

Uses.—Externally as a **Dusting Powder,** "Dermatol"; internally intestinal antiseptic and astringent.

Dose.—0.25 Gm. (4 grains).

Bismuth Subsalicylate.—Bismuthi Subsalicylas, U. S.—Should contain 62-64 per cent Bismuth Oxide.—By interaction of solution of Salt of Salicylic Acid and of Bismuth.

A nearly white powder, insoluble in all neutral liquids.

Uses.—As an intestinal antiseptic.

Dose.—0.25 Gm. (4 grains).

QUESTIONS ON LECTURE VI—SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all the rules of the "Important Notice" must be complied with. **The Director.**

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1. Enumerate the Alkaline Earths. How do their Carbonates differ **physically** from the Carbonates of the Alkalies?

2. How do the following differ **physically** and **chemically**. Marble Dust, Whiting, Chalk, Prepared Chalk, Precipitated Chalk?

3. What pharmacal **operation** is involved in the manufacture of Lime? In the preparation of Prepared Chalk?

4. What is "Milk of Lime?" How prepared? What is "Lime Water?" **chemically?**

5. What official Compounds are prepared from $SrCO_3$? State their Chemical Formulas.

6. Give the Chemical Formula, official Latin and English Titles and medicinal properties of "Epsom Salt." What is the dose?

7. Mention the chemical formulas for Magnesium Carbonate and for Magnesia, U. S. Ph.

8. What is Magnesia? How is it obtained?

9. How are **light** and **heavy** Magnesium Carbonate prepared, respectively?

10. What compound of Ce is official? How it is prepared?

11. State the chemical formula for Alumen, U. S. Ph., also its **action** on live tissues. What other **form** official and how prepared.

12. What compounds of Cr are official? What **care** should be taken in handling it?

13. What is the therapeutic action of Zinc Sulphate?

14. In making Zinc Chloride what **gas** is produced? What impurity must be gotton rid of, and how?

15. What distinguishes **physically** the compounds of Manganese from those of Magnesium?

16. Give the official title for preparation replacing "Black Oxide of Manganese."

17. Mention the two **series** of compounds of Iron and Mercury.

18. What is Monsell's Solution and what is its therapeutic action?

19. How are the Scaled Salts of Iron prepared?

20. Give the Official Titles of three forms of **ferrous** Sulphate.

21. Give the Official Titles of four preparations of Ferrous Carbonate: from **what** and **how** made?

22. What is the color of all **Ferrous compounds** and preparations?(b) Of **Ferric?**

23. What are Litharge, Sugar of Lead and White Lead?

24. Give the Official Titles of "Goulard's Extract," "Goulard's Cerate," and "Lead Water."

25. What is the best Antidote for acute Lead poisoning?

26. Give the Chemical Names of: Green Vitriol, White Vitriol, Blue Vitriol. How do they derive the name "vitriol?"

27. Name the Official Compound of Gold, and state how it is prepared.(b) What is its use in medicine?

28. What is the principal compound of Silver? Give the Titles for its 3 Forms. What is "**Lunar Caustic.**"

29. Name 5 Preparations containing **metallic** Mercury, with their strengths.

30. What is "Gray Powder?" (b) "Blue Mass." (c) "Blue Ointment."

31. How much **Blue Ointment** can be made from 150 Gm. **Mercurial Ointment?**

32. How do the 2 Chlorides of Mercury **differ** in physical properties, chemically and medicinally? Give internal dose of each.

33. How do the 2 Iodides and the 2 Oxides **differ** in the same respects?

34. State the difference between, biniodide, red iodide, protoidide, green iodide and yellow iodide of mercury.

35. Give the Official Chemical Titles of Red Precipitate, White Precipitate, Calomel, Corrosive Sublimate, Tartar Emetic.

36. What does the therapeutic value of the two principal Bismuth Compounds chiefly depend upon? What dangerous impurity must be excluded in their preparation?

CELLULOSE DERIVATIVES.

Cellulose or Cellulin constitutes the principal portion of the cell-walls of plants, and together with one of its modifications, **lignin,** it represents the greater proportion of dried wood. Because of its wide distribution Cellulose is an important substance, and in some of its modifications, such as **cotton, paper, wood** and **coal,** is the most nearly indispensable substance to mankind.

Cellulose has the same chemical composition as Starch, $C_6H_{10}O_5$, or a multiple of this and, like it, may by the action of acids be converted into **glucose.** These substances have therefore been designated chemically as the Cellulin group and have been thus treated in works of chemistry. For the purposes of pharmacy, however, this classification is not desirable, as each class is best studied by itself.

Pharmaceutically and chemically considered Cellulose furnishes some of the most important chemical and technological agents, which may be grouped according to the methods of deviation as follows:

Cellulose:

A. By separation of Lignin and impurities:

1. Mechanical.—Cotton, Linen, Jute.
2. Pharmaceutical.—Paper, Purified Cotton, Lint.

B. By chemical decomposition:

3. By Nitration.—Nitro-Cellulin—Pyroxylin.
4. From oxalates with H_2SO_4. Oxalic Acid.
5. By destructive distillation: Pyroligneous Acid, Tar, Charcoal.

These will be treated in the order that they are derived, together with their compounds and preparations.

FORMS AND MODIFICATIONS OF CELLULOSE.

Cellulose occurs in a fairly pure form in the bast-cells of certain plants, such as the **Flax, Hemp,** etc., and in a still purer form in the hairs attached to the seed of the **Cotton** plant.

They consist of single elongated, rather thin-walled cells which, when dry, collapse and form flattened and somewhat twisted bands. But these fibers in their natural form contain more or less coloring and resinous matter of which they must be freed before being used for making the finer fabrics and especially before they can be used in pharmacy. Their chief value in pharmacy depends upon their power of **absorbing** liquids due to the capillary attraction exercised by the cells, which renders these forms

of Cellulose invaluable in surgery to abstract irritating liquid (pus), thus keeping the wound clean. They are also used as filtering **media** for the same reason.

Purified Cotton.—Gossypium Purificatum. U. S.—Absorbent Cotton.—The hairs of the seed of Gossypium herbaceum L., freed from adhering impurities and deprived of fatty matter.

The "raw" cotton is boiled in an alkaline solution, washed and immersed in a solution of Chlorine, again washed with water and then with dilute Hydrochloric Acid, rinsed thoroughly in weak Alkaline water and finally in pure water and then dried.

The cotton so treated has great absorbent power, is insoluble in all ordinary solvents, but soluble in copper ammonium sulphate solution.

Uses.—In surgery and for the preparation of Antiseptic Cottons by saturating it in solutions of antiseptic agents, such as Boric Acid, Mercuric Chloride, etc.

Other forms of Cellulose used in surgery are **Lint** made from Linen obtained from the Linum usitatissimum, Hemp and Jute.

The principal modifications of Cellulose are **lignin**, the thick-celled portion or wood, and **suberin**, which constitutes the principal portion of **Cork**.

Paper.—Charta.—Is prepared from Cellulose direct in the form of wood, straw, or linen rags by heating with steam under pressure in revolving cylinders with Alkalies, beating into a pulp and bleaching with Chlorine. The pulp is transferred to endless felt-belting revolving on heated cylinders and dried, the sheets finally being pressed between rollers to give them a smooth or "**calendered**" surface.

Paper to which no glue or similar substance has been added is called "**unsized**" paper, and is the kind directed for the official Paper.

Chartula means small paper, and has reference to the paper used for enwrapping powders, hence its use in dispensing directions. For this purpose wax and **paraffin** paper is also employed.

Parchment paper is prepared by dipping unsized paper in cold 50-per-cent Sulphuric Acid, then in Ammonia Water, rinsing in pure water and finally rolling it so as to give a polished surface. The acid converts the surface of the paper into a gummy substance which gives to the paper great strength.

CELLULOSE PRODUCTS BY CHEMICAL DECOMPOSITION.

Nitro-Cellulose—Gun Cotton.—By treating Purified Cotton with a cooled mixture of Nitric and Sulphuric Acids, Nitric Acid Esters are formed in which one, two or more hydroxyl groups have been displaced by a corresponding number of groups of the Nitric Acid radical.

The terms **di, tetra hexa**—nitrate of Cellulose are used to designate the respective compounds.

The **explosive** kind or true Gun-Cotton is the highest of the series; it is insoluble, while the official kind is chiefly Cellulose tetra nitrate, which is soluble in Ether-alcohol and is slightly explosive.

Pyroxylin.—Pyroxylinum, U. S.—Soluble Gun Cotton.—Consists chiefly of Cellulose tetra-nitrate $C_{12}H_{16}(ONO_2)_4O_6$.

It is soluble in Ether-alcohol; is slightly explosive and should be kept in cartons protected from light and heat.

From this the official class of Collodions are prepared by solution in Ether and Alcohol and addition of medicinal agents.

Collodium, U. S.—Pyroxylin 4 Gm., Ether 75 CC., alcohol 25 CC.

Collodium Flexile, U. S.—5 Canada Turpentine, 3 Castor Oil, Collodion to 100 Gm.

Collodium Cantharidatum, U. S.—Chloroformic Extract of 60 Gm. Cantharides, concentrated to 15 Gm. and Flexible Collodion tc 100 Gm.

Collodium Stypticum, U. S.—20 Gm. Tannic Acid dissolved in alcohol 5 C.C. and ether 25 C.C. and mixed with Collodion to make 100 C.C.

Celluloid is Collodion and Camphor made into a paste with various oxides and carbonates of Zinc, etc., and compressed into molds.

Oxalic Acid.—$H_2C_2O_4$.—Acidum Oxalicum.—Not official.—A dibasic acid widely distributed in the vegetable kingdom, occurring as acid Potassium Oxalate in sorrel and some other plants, but more commonly in combination with Calcium in rhubarb, curcuma, etc. This latter compound is also found in the animal body.

It may be made from Sugar by the action of Nitric Acid and in other ways, but commercially it is made by heating Saw-dust with Potassa and Soda, forming Oxalates of Potassium and Sodium. By Sodium Carbonate the former is converted into Sodium Oxalate which is formed into Calcium Oxalate by the addition of Calcium Hydrate. This Calcium Oxalate is decomposed by Sulphuric Acid into insoluble Calcium Sulphate, Oxalic Acid being set free and obtained by crystallization from the solution.

Tabular crystals, colorless, intensely sour, soluble in 8 parts of cold water and in all proportions in boiling water. The pure acid does not blacken when heated on platinum foil, but melts at about 100°C. and sublimes at about 160°C., being partly decomposed into carbon monoxide and carbon dioxide. The acid is very **poisonous**; the proper **antidote** is chalk or magnesia.

Oxalic acid itself is not official, but represented in the Volumetric Solution for quantitative testing. [See U. S. Ph.]. It is used for making the **Oxalates**.

PRODUCTS OF DESTRUCTIVE DISTILLATION OF WOOD.

When wood is burned in a furnace without access of air, or as in the "burning" of Charcoal, the resulting products may be summarized as follows in order of their derivation:

Gases. 25% Non-Condensable.	Carbon monoxide, CO; dioxide, CO_2. **Marsh Gas**, CH_4; Acetylene, C_2H_2. Propene, C_3H_6; Ethylene, C_2H_4.
Vapors. 50% Condensable Liquid.	Acetone, Furfurol. Methyl Alcohol, Methylamine. **Acids.**—Acetic, Formic, Butyric. Crotonic, Capronic, Propionic.
Tarry Liquid, 10%	**Tar**, Creosote. Toluol, Xylol, Cumol, Methol. Creosol, Phlorol. Naphthalene, Pyrene, Chrysene. Paraffin.
Solid Residue, 15%	**Charcoal**, Inorganic Salts.

The **Gases** are of but little importance, sometimes being utilized as **fuel** during the process of distillation.

The **liquid** obtained after separation from the tarry portion constitutes the so-called **pyroligneous acid**, or "crude wood vinegar." This is treated with Lime which neutralizes the acids forming Calcium Acetate, etc., and upon distillation yields the readily vaporizable liquids, Acetone and Methyl Alcohol which come over and are condensed in the order of their respective boiling points.

Acetone.—$CH_3.CO.CH_3$—Acetonum—U. S.—Pyroacetic Ether. —Chemically known as dimethyl ketone, is a very volatile liquid, boils at 56°C. and is the first liquid that comes over in the distillation of wood. It has the sp. gr. of 0.79, soluble in all proportions of water, alcohol and ether.

It has great solvent properties, readily dissolving gun-cotton, camphor, resins, oils, etc. It is used for the production of Chloroform and Acetophenon or Hypnon, a liquid of hypnotic properties.

Methyl Alcohol.—CH_3OH.—Commonly called "wood alcohol" or "wood naphtha." The product obtained as above, purified by rectification, is known as **Columbia Spirit.**

Limpid, colorless, volatile liquid, of a peculiar odor, and a warm alcoholic taste, sp. gr. 0.820, boiling point 65°C., soluble in all proportions of water, alcohol and ether.

Uses.—It is not used in medicine but as a solvent for fixed and volatile oils, resins, etc., largely in the arts. **Methylated spirit** is common alcohol mixed with 25 per cent of methyl alcohol, used in England for industrial purposes, free from internal revenue tax.

Formaldehyde.—H.COH.—A Gas at ordinary temperatures produced through oxidation of methyl alcohol is official as solution in water.

Solution of Formaldehyde.—Liquor Formaldehydi, U. S.— Containing not less than 37 per cent by weight of the Gas.

Commonly known as Formalin, Formol, etc., also as polymerized solid **Paraform.** The gas readily volatilized from the solution, is suffocating and irritating to mucous membrane and should not be inspired.

Uses.—As disinfectant and germicide for fumigating sick chambers, etc. **Externally** only in very dilute solutions. **Internally** an irritant poison.

Hexamethylenamine.—$(CH_2)_6N_4$.—Hexamethylenamina, U. S. —Hexamethylene Tetramine. — A condensation product of Formaldehyde and Ammonia.

Tabular crystals, colorless, without odor and of decided alkaline reaction. Soluble in 1.5 parts of Water, in 10 parts of Alcohol, sparingly in Ether.

Uses.—A urinary antiseptic and deodorant in renal disorders, in the form of solution.

Average Dose.—0.25 Gm. (4 grains).

Acetic Acid.—$CH_3.COOH$.—A monatomic acid having one replaceable hydrogen atom.

Found in plant-juices free and combined with Calcium and Potassium especially in the **wood.** Also in animal organism, in the perspiration and in the **urine.**

Acetic Acid may be obtained in two ways:

1. By decomposition through oxidation and fermentation.
2. By distillation of wood and through decomposition of acetates.

Commercially it is chiefly obtained from crude Calcium Acetate obtained by destructive distillation of wood as above referred to, treated with sodium sulphate; in the double decomposition which takes place, insoluble calcium sulphate is formed and the solution of sodium acetate is evaporated to dryness, heated to about 260°C., to char any remaining organic impurities. The residue dissolved in water is treated with sulphuric acid, separated from the crystals of sodium sulphate, the acid is obtained by distillation.

In the **oxidation method** or the "quick vinegar process," a dilute alcoholic solution (5 to 7%) is permitted to drip slowly through a large cask perforated with holes for free circulation of air and filled with clean wood shavings. On this is poured some warm vinegar, fermented malt liquor, or some "mother of vinegar" which contains miscroscopic plants **(mycodermi aceti)**, that act as a ferment. The alcoholic solution is now permitted slowly to drip through the cask; soon the shavings become coated with the ferment organisms, oxidation of the alcohol takes place, the temperature of the interior of the cask rises, causing a free circulation of air, and the alcoholic solution is now rapidly converted into a more or less impure solution of acetic acid, which issues in a slow stream from an orifice in the bottom of the cask, and is called **vinegar.**

Vinegars are also made by fermentation of the poorer qualities of wine, of cider (cider vinegar), of malt (malt vinegar), etc. In all these processes, alcohol is first produced by the fermentation of a saccharine solution, and then the alcohol, by agency of the **mycodermi aceti** and exposure

of the liquid to the air, is oxidized to acetic acid. Pure acetic acid may be obtained from vinegar by a process similar to that which has been described for obtaining it from wood vinegar.

Acetic Acid is official in the following forms:

Acetic Acid.—Acidum Aceticum, U. S.—A liquid composed of 36 per cent of absolute acid and 64 per cent by weight of water; sp. gr. 1.045.

A clear, colorless liquid, having a strong, vinegar-like odor, a purely acid taste and a strongly acid reaction, miscible in all proportions with water alcohol, etc.

The percentage strength of Acetic Acid is not accurately disclosed by its specific gravity, as this varies irregularly, but is best determined volumetrically.

Dilute Acetic Acid.—Acidum Aceticum Dilutum, U. S.—A liquid containing 6 per cent by weight of absolute acid. Prepared by mixing 100 Gm. of the official Acid with Distilled water to make 600 Gm.; sp. gr. 1.008.

This is used as a menstruum for the official Vingars.

Glacial Acetic Acid.—Acidum Aceticum Glaciale, U. S.—Nearly or quite absolute acid, 99 per cent; sp. gr. 1.049.

Liquid at ordinary temperature but becoming a crystalline mass below 15°C. Commercial Acetic Acid, or "No. 8," contains about 28 per cent of acid. It possesses a disagreeable empyreumatic odor and taste, which unfits it for medicinal purposes.

Tar.—Pix Liquida, U. S.—Product of the destructive distillation of the wood of various species of Pine, chiefly Pinus palustris.

Blackish-brown, thick semi-fluid, odor empyreumatic and terebinthinate; taste bitter, empyreumatic, and somewhat acrid; soluble in alcohol, ether, chloroform, solutions of soda and potash, the fixed and volatile oils, and sparingly soluble in water.

Uses.—Stimulant and irritant. Given internally, and used also externally in ointments and plasters, and for fumigations.

Off. Prep.—Syrupus Picis Liquidæ; Unguentum Picis Liquidæ.

Oil of Tar.—Oleum Picis Liquidæ, U. S.—Obtained by distillation of Tar.

Oil of Cade.—Oleum Cadini, U. S.—Obtained by destructive distillation of Juniper wood; are considered among the empyreumatic volatile oils.

Creosote.—Creosotum, U. S.—A mixture of several substances belonging to the class known as Phenols, obtained by distillation of wood-tar, preferably that from Beech, with a boiling point above 200°C., consisting chiefly of Guaiacol, $C_7H_8O_2$ and Creosol, $C_8H_{10}O_2$.

The distillate from tar separates into two layers, the heavier portion is freed from impurities by treating it alternately with caustic potash and sulphuric acid, and the portion boiling between 200 and 220°C., is separated by fractional distillation.

An almost colorless oily liquid, becoming darker with age and upon exposure, of a penetrating, smoky odor and burning, caustic taste. Boils above 200°C, becomes gelatinous but does not solidify at the freezing point (difference from Carbolic Acid). It is inflammable, burning with a smoky flame and coagulates the albumen of the skin, thereby producing a white stain when applied to it.

It is of almost neutral reaction, sp. gr. about 1.070. Soluble in 140 parts of water, in somewhat less of hot water, soluble in all proportions in alcohol, ether, chloroform, fixed and volatile oils, benzin and carbon disulphide.

Creosote is largely adulterated with "Carbolic Acid," from which it may be distinguished by the above physical properties and also by the following test:

If to a 10 per cent solution of Creosote in Alcohol is added a little Ferric Chloride solution a violet coloration will be produced which is discharged upon diluting the solution with water. With Phenol or "Carbolic Acid" the coloration is not discharged.

Uses.—To deaden pain and preserve tissue as an application in toothache. Internally to allay nausea, consumption and lung diseases.

Off. Prep.—Aqua Creosoti, a saturated solution.

Average Dose.—0.2 cc. (3 minims).

Guaiacol.—$C_7H_8O_2$.—Guaiacol, U. S.—One of the chief constituents $C_6H_4(OH)(OCH_3)$ of Creosote, which contains about 85 per cent of it, obtained by purification and fractional distillation. It is also prepared synthetically by methylization of catechol or by diazotising ortho-anisidin.

A colorless refractive liquid of an agreeable aromatic odor sp. gr. 1.140, or a crystalline solid melting at 28.5°C. Soluble in 53 parts of water, in alcohol and ether in all proportions and in 1 part of glycerin.

Uses.—As a substitute for creosote in tuberculosis, in elixirs, syrups, oils, emulsions and in capsules.

Average Dose.—0.5 C.C. (8 minims).

Guaiacol Carbonate.—$(C_7H_7O)_2CO_3$.—Guaiacolis Carbonas, U. S.—Obtained by the action of Carbonyl Chloride on Sodium Guaiacolate.

An almost tasteless odorless white crystalline powder, insoluble in water, soluble in 48 parts of alcohol, in 1.5 parts of choloroform, slightly soluble

Uses.—Same as Guaiacol in tuberculosis in powder.

in glycerin and fatty oils.

Average Dose.—1 Gm. (15 grains).

COAL-TAR PRODUCTS.

By the destructive distillation of Coal, as in the burning of Coal in Gas-works, a series of compounds quite similar to those derived from wood are obtained.

Gases which furnish the illuminating gas, Hydrogen, and its Carbon Compounds known as the Marsh Gas, CH_4, Series.

Liquids which comprise the Hydrocarbons, Benzol or Benzene or "Coal-tar benzin," Toluol, etc.; the **acid** constituents, Phenol, Cresol, etc., and a great variety of **bases** of the Ammonia type.

Solids, Naphthalin, etc., and finally, the residue, **Coke.**

Of all of these substances only a few are official, although from nearly all of them valuable chemical and medicinal agents are obtained.

Phenol.—C_6H_5OH.—Phenol, U. S.—Acidum Carbolicum, U. S. '90.—This is not an acid but chemically a Phenol or Hydroxybenzene, hence the change of name. It is obtained from Coal-tar by fractional distillation and purification or made synthetically. It should contain not less than 96 per cent absolute Phenol.

The Crude Carbolic Acid obtained by fractional distillation of that portion of coal-tar known as "dead oil" is treated with Caustic Potash, the crystals of Potassium Carbolate are heated to 170°C. to char organic impurities, dissolved in water and the acid is set free, by supersaturation with Hydrochloric Acid, as an oily liquid. This is freed from water and finally obtained in crystals by condensing the distillate at the freezing point.

Colorless, acicular crystals, or a crystalline mass, usually acquiring a reddish tint, having an aromatic odor and a sweetish, burning taste; its vapor is inflammable. Soluble in 19.6 parts of water, very soluble in alcohol, ether, chloroform, benzol, carbon disulphide, fixed and volatile oils. Soluble in glycerin, but almost insoluble in benzin (difference from creosote).

Phenol **resembles creosote** in its odor, in its caustic properties, in its antiseptic power, and in many of its uses, but **differs** from it in chemical composition, in being a solid at ordinary temperatures, in having a lower boiling point, in its power to coagulate collodion when mixed with it, and in its far greater solubility in water.

Phenol Liquefactum, U. S.—A liquid composed of 86.4 per cent absolute Phenol and 13.6 per cent of Water. Prepared by melting the Phenol contained in an unstoppered bottle in a water-bath and mixing it with 10 per cent of its weight of Distilled Water. By using **alcohol,** instead of water, solution may be effected without the use of heat by simply placing the containing vessel "upside down," after the alcohol has been added.

Uses.—The most important uses of Phenol are as a disinfectant and antiseptic. As a **dressing,** it is usually applied in the form of carbolated oil, or petrolatum. The lotion is prepared by dissolving one part of the acid in thirty of hot water. For internal administration only the purest kinds should be dispensed. The dose is about 0.06 (1 grain) largely diluted.

Antidote.—A powerful caustic and deadly poison taken internally ex-

cept in medicinal doses. Alcohol prevents its caustic effect and should be first administered followed by large doses of magnesium sulphate in solution which forms a comparatively harmless compound.

Average Dose.—0.065 Gm. (1 grain).

Off. Preps.—Unguentum Phenolis; Glyceritum Phenolis.

Care must be observed to distinguish between: The **Solution** of Phenol, a saturated solution of 5 per cent in water, and the **liquefied** Phenol made by the addition of 10 per cent of water or alcohol.

Cresol.—C_7H_7OH.—Cresol.—Formerly known as Cresylic Acid [$C_6H_4(CH_3)OH$], a mixture of three isomeric cresols obtained from Coal-tar and separated from Phenol by fractional distillation.

A refractive liquid of a strong Phenol-like odor. Colorless but becoming brownish on exposure to light; sp. gr. 1,032. Soluble in 60 parts of water, in all proportions of alcohol, ether, benzene, petroleum, benzin, glycerin and alkaline solutions.

Average Dose.—0.05 cc. (1 minim).

Liquor Cresolis Compositus, U. S.—A 50 per cent solution of Cresol in Soft-Soap.

Made by mixing Cresol 50 Gm., with a solution of Potassium Hydroxide 8 Gm., water 5 Gm., and Linseed Oil 35 Gm., allowing it to stand and adding Water to make Gm. 100.

Uses.—As a disinfectant and deodorizer; in 1 to 5 per cent solutions a vaulable antiseptic more certain than phenol without its poisonous properties. Creolin, Lysol, are similar preparations.

Salicylic Acid.—$HC_7H_5O_3$.—Acidum Salicylicum, U. S.—A monobasic organic acid existing naturally as Methyl Salicylate in Gaultheria and other plants but made chiefly synthetically from Phenol.

It may be obtained by heating Oil of Gaultheria with Potassa until the liberated Methyl Alcohol is volatilized and decomposing the Potassium Salicylate thus formed with Hydrochloric Acid, which separates the Salicylic Acid in the form of crystals.

Commercially Salicylic Acid is made by treating Phenol with Sodium Carbonate and subjecting the Sodium Phenolate so formed to Carbon Dioxide, by which it is converted into Sodium Salicylate and decomposing this by Hydrochloric Acid, which sets the Salicylic Acid free.

Colorless, needle-shaped crystals, acid and slightly acrid to the taste; melting at 156°C., sublimes unaltered if carefully heated to 200°C. Soluble in 308 parts of water, in 2 parts of alcohol, in 2 parts ether and in 80 parts chloroform. Salicylic acid should be free from the odor of phenol, and its solution in cold sulphuric acid should be colorless, or have only a slightly yellow color, showing the absence of organic impurities.

Uses.—Salicylic acid and its compounds, particularly Sodium Salicylate, are extensively used and of great value in acute articular rheumatism. The acid is also of much value as an antiseptic and preventive of fermentation.

Sulpho-Carbolic Acid is a compound of Phenol and Sulphuric Acid. The Phenol Sulphonates are used as an antiseptic and furnishes several salts.

Phenyl Salicylate.—$C_{13}H_{10}O_3$.—Phenylis Salicylas, U. S.—Salol U. S. '90.—The Salicylic ester [$C_6H_4(OH)COOC_6H_5$] of Phenol. Made by interaction of Phenol and Salicylic Acid.

A white crystalline powder of faint aromatic odor and taste; practically insoluble in water (2333) readily soluble in other solvents, alcohol, ether, fixed and volatile oils and fusing at 42°C.

Uses.—Antipyretic and anti-rheumatic in powder or encapsuled.

Average Dose.—0.5 Gm. (7½ grains).

Acetphenetidin.—$C_{10}H_{13}NO_2$.— Acetphenetidum.— Phenacetin. —A Phenol derivative. Acetparaphenetidin [$C_6H_4(OC_2H_5)NH.$-CH_3CO], made by acetylizating para-amidophenetol.

White crystalline scales or powder, without odor and taste, soluble in 925 parts water, 12 parts alcohol, 63 parts ether and 20 parts chloroform.

Uses.—Analgesic and antipyretic, in powder or encapsuled.

Average Dose.—0.5 Gm. (7½ grains); this Dose should not be exceeded.

Antipyrin.—$C_{11}H_{12}N_2O$.—Antipyrina, U. S.—Phenyldimethylpyrazolon [$C_3HN_2O(CH_3)_2C_6H_5$], by condensing phenylhydrazin with aceto-acetic ether and methylization.

Crystalline powder, or colorless tabular crystals without odor, of slightly bitter taste. Very soluble in water, alcohol and chloroform and in 30 parts ether. Incompatible with all reducing agents.

Uses.—Analgesic and antipyretic, in powder or encapsuled.

Average Dose.—0.25 Gm. (4 grains), which should not be exceeded.

Benzosulphinide.—$C_6H_4SO_2CONH$.—Benzosulphinidum, U. S.—Saccharin, the anhyride of orthosulphamide-benzoic acid. Prepared from Toluol by a complicated reaction.

White crystalline powder of intensely sweet taste even in dilute solution. Soluble in 250 parts of water, in 25 parts of alcohol, slightly soluble in ether and chloroform, soluble in the alkalies.

Uses.—As a sweetener; powerful antiseptic; its use is not to be recommended.

Benzol.—HC_6H_5.—Benzene.—Phenyl Hydride.—Obtained from Coal-tar by fractional distillation.

A colorless liquid boiling at 80°C., sp. gr. 0.878. A great solvent for fat, wax, resin, etc.

From Benzene a great many substances are produced, among which the following are the most important:

Nitro Benzene.—$C_6H_5NO_2$.—Oil Mirbane.

Aniline.—$C_6H_5NH_2$.—Phenylamine, "anilin oil."

Acetanilide.—C_8H_9NO.—Acetanilidum, U. S.—A monacetyl derivative [$C_6H_5NH(CH_3.CO)$] of Aniline. Made by interaction of Aniline and Glacial Acetic Acid.

A crystalline powder soluble in 179 parts of water, in 25 parts of alcohol, 18 of ether, in 5 parts chloroform.

Uses.—As an antipyretic and analgesic; in powder or encapsuled.

Average Dose.—0.25 Gm. (4 grains); it should be used with great caution.

Pulvis Acetanilidi Compositus, U. S.—A mixture of Acetanilide 70 parts, Sodium Bicarbonate 20, Caffeine 10 parts.

Dose.—0.5 Gm. (7½ grains).

Resorcinol.—$C_6H_6O_2$.—Resorcinol, U. S.—Resorcinum, U. S. '90.—A diatomic Phenol, Meta-dihydroxy Benzene, $C_6H_4(OH)_2$, obtained by action of alkalies on meta-benzene disulphonates.

Faintly reddish crystals, very soluble in alcohol and water.

Uses.—Antiseptic, in solution, ointments, etc.

Average Dose.—0.125 Gm. (2 grains).

Methylthionine Hydrochloride.—$C_{16}H_{18}N_3SCl$.— Methylthioninae Hydrochloridum, U. S.—Methylene Blue.—Tetra-methylthionine Hydrochloride, derived from Para-amidodimethyl-Aniline.

A dark green powder, or in crystals, readily soluble in water and in alcohol; the solution has a deep blue color.

Uses.—Antiseptic and deodorant.

Average Dose.—0.25 Gm. (4 grains).

Naphthalene.—$C_{10}H_8$.—Naphthalenum, U. S. Naphtalinum.—U. S. '90.—Obtained as an end-product in the fractional distillation of Coal-tar.

Crystalline plates insoluble in water. Soluble in 13 parts alcohol, very soluble in ether, chloroform, fixed and volatile oils.

Beta Naphthol.—$C_{10}H_7OH$.—Beta Naphthol, U. S.—Naphtol, U. S. '90.

Buff-colored, shining plates, phenol-like odor, almost insoluble in water (1000), very soluble in alcohol, ether, etc.

Uses.—As antiseptics and disinfectants.

Dose.—0.25 Gm. (4 grains).

PETROLEUM DERIVATIVES.

Petroleum.—Also known as Coal Oil, Rock Oil, Stone Oil, Seneca Oil, etc. A liquid mixture of Hydrocarbons with boiling points ranging from 30°C. to 300°C. and over. These may be separated by fractional distillation, among which the following are the most important:

Rhigolene—Boiling point 30°-45°C., lightest liquid known.

Petroleum Benzin—Benzin, U. S.—C_5H_{12}—C_6H_{14}.—Boiling point 45°-60°C., sp. gr. 0.638 to 0.66.

Kerosene, rectified petroleum freed from the preceding.

Benzinum Purificatum, U. S.—Petroleum Benzin purified by washing with Sulphuric Acid and Potassium Permanganate.

At a temperature above 300°C. paraffin comes over in the three stages of physical form; liquid, semi-solid and solid, according to the relative proportions of the liquid Hydrocarbons and the solid Paraffin, which they hold in solution. The product after purification is official in the following forms:

Liquid Petrolatum.—Petrolatum Liquidum, U. S.—Paraffine Oil.

Petrolatum.—Petrolatum, U. S.—Melting point between 40° and 45°C. (104°F.—113°F.). This is the product dispensed for Petrolatum, "Vaselin" and "Cosmolin."

White Petrolatum.—Petrolatum Album, U. S.

Uses.—As vehicles for external medication. Not absorbable and should not be used instead of vegetable and animal fats, when medicinal action other than that exerted on the skin surface is required.

Paraffin—Paraffinum U. S.—A wax-like substance is the end-product.

Uses.—In Ointments, etc.

THE CARBO-HYDRATES.

The carbo-hydrates include the Starches, Sugars and Gums; cellulose and lignin being also sometimes classed with these.

They are closely related chemically, and agree in containing the Hydrogen and Oxygen in the same proportion in which these elements occur in the **water-molecule**, that is twice as much Hydrogen as Oxygen.

In the processes of vegetable life, all other substances appear to be produced either directly or indirectly from starch.

STARCHES.

Starch appears to be the first product of the assimilative process in the plant, and is made directly from Water and Carbon Dioxide by the agency of chlorophyl and sunlight. It first makes its appearance in the chlorophyl bodies, where, by means of a good microscope, aided by appropriate tests, it may be discovered; it then passes into some soluble form, as glucose, dextrin, or some other of the many forms of **sugar**, and is carried in the sap of the various parts of the plant, and either again stored up as starch in the roots, seeds, etc., or converted into **fixed oils** for the future uses of the plant, or it is formed into cellulose, lignin, suberin, gum, or, by reactions with nitrates or ammonia compounds and sulphates, it is converted into **proteid** compounds.

Starch is, in other words, the formative material of the plant, from which, in the long run, all its tissues are built up.

It usually exists in the cells in the form of **minute granules**, in seeds, in roots and in the pith of some plants, as the Sago Palm also, in the leaves, bark, and even wood. The granules differ widely in shape and size, often so characteristic of certain species of plants that their source may be determined by microscopical examination. Usually the grains possess a nucleus or **hilum** which is sometimes centrally and sometimes excentri-

cally located, and around this nucleus concentric markings are frequently seen.

The starch grain is composed of about 95 per cent **granulose** and about 5 per cent **starch cellulose.** By digestion with saliva at 38°C., the granulose dissolves, leaving a perfect skeleton of the grain in starch cellulose, which acquires a yellowish coloration with Iodine while the granulose is stained a deep violet color.

Starch.—Amylum, U. S.—The starch grains obtained from the fruit of Zea Mays, L., India Corn. It has the chemical formula $C_6H_{10}O_5$ or some multiple of this. The Starch is obtained by reducing the grain to coarse powder and washing with water to free the starch-grains from the seed coating and other adhering substances. After thoroughly washing, the starch is collected and dried.

In irregular masses or fine white powder, inodorous, tasteless, insoluble in neutral solvents but when boiled with water yields a white jelly with a bluish tinge. Owing to its staining effect, iodine is the best reagent for detecting the presence of starch.

Off. Prep.—Glyceritum Amyli, containing 10 per cent.

A large number of isomers of starch are known, among the more important of which are Dextrin, Lichenin, Inulin and Glycogen.

Dextrin is soluble in water, and does not react with iodine to produce a violet color. As found in the plant it probably represents transition stages in the process of change from starch to the sugars. It may be produced artificially by heating starch paste to a temperature of 260°C. Also by the action of Oxalic Acid, Nitric Acid, or Sulphuric Acid on Starch. Its solution is largely used as a **mucilage.**

Lichenin is the peculiar form of starch which is found in Iceland moss.

Inulin replaces starch in the roots of Inula, Taraxacum, Cichorium, and other Compositæ. In its properties it stands between starch and sugar.

Lævulin is found associated with inulin in some of the Compositæ.

Glycogen is found in the liver of man and many other animals.

These starches form a group called the Amylum Group. They are all transformed by the action of acids into **glucoses.**

Starch Drugs or Starches.

Arrow Root.—Maranta.—From the root of Maranta arundinaceæ.

Canna.—From the rhizome of Canna edulis.

Cassava.—Brazilian Arrow Root, from the root of Manihot utilissima.

Tapioca.—From the above by drying on iron plates.

Sago.—The pith of Metroxylon Sagu, granulated and dried.

Rice Starch.—Amylum Oryzæ.—From the seed of Oryza sativa.

Wheat Starch.—Amylum Tritici.—From the seed of Triticum vulgare.

Potato Starch.—Amylum Solani.—From the Potato.

SUGARS.

The Sugar Group consists of compounds closely related to the starches, but they are **crystalline, sweet** or sweetish to the taste, and more or less **soluble** in water. They are divided into two classes, the Saccharoses and Glucoses.

The **Saccharoses,** of which common cane sugar is the type, have the formula $C_{12}H_{22}O_{11}$. The principal members of the group are:

Cane sugar,	Milk sugar,	Maltose,
Melitose,	Trehalose,	Melezitose.

They are all characterized, optically, by deviating the plane of polarized light to the **right,** and chemically by being convertible by boiling with dilute sulphuric acid into **glucoses.** They differ also from the glucoses in **not** being directly fermentable.

Cane Sugar.

Cane sugar, the most important member of the group, is widely distributed in the vegetable kingdom, but its principal commercial sources are the Sugar Cane, the Sugar Beet, certain of the Palms, and the Sugar Maple. The sugar is contained in solution in the sap of these plants.

The process of obtaining it from the sap varies with the different sources, but consists essentially in the following:

(1) Getting rid of albuminoid impurities by treatment with Milk of Lime.

(2) Concentration by evaporation and the separation of the crystallizable from the uncrystallizable portion.

(3) Refining the crude crystalline product by dissolving it, treating it with Animal Charcoal, concentrating and crystallizing.

Sugar.—Saccharum, U. S.—The refined sugar of Saccharum officinarum, L., and from various species or varieties of Sorghum, also from the Beta vulgaris.

The **purity** of Sugar, that is, its freedom invert Sugar which favors fermentation, is determined by its dextrogyrate power in the **Polariscope.**

Pure cane sugar crystallizes in colorless crystals of sp. gr. 1.593. Soluble in one-half its weight of water, in 138 parts alcohol, in 28 parts boiling alcohol, but insoluble in ether, chloroform, etc. Its melting point is about 160°C.; when heated to a higher temperature it gradually undergoes change, and is converted into Caramel. More strongly heated, the caramel is decomposed, and a mass of porous charcoal is left behind.

Many compounds of sugar, with bases, are known, but only one, the saccharate of calcium, is of importance in pharmacy, under the name of **Syrupus Calcis,** U. S. Ph.

Uses.—In the preparation of Syrups, Elixirs, and many Mixtures both solid and liquid. As a preservative, diluent and excipient in Pill-Masses, Confections, Troches, etc.

Eleosacchara, or Oil Sugars, are mixtures of some volatile oil with sugar, 1 drop to 30 grains, N. F.

Other Saccharoses are the following:

Milk Sugar.—Saccharum Lactis, U. S.—Occurs in the milk of mammalia, particularly in cow's milk. It is prepared from whey by concentration and crystallization.

Crystalline, less sweet to the taste than cane sugar, soluble in 6 parts of cold and 1 part of boiling water, insoluble in alcohol, ether or chloroform.

Uses.—Valuable as a **diluent** and as such used for the official class of preparations, the **Triturations.**

Melezitose is a sugar found in certain mannas, particularly Abies larix.

Melitose, the principal constituent of the manna that exudes from Eucalyptus manifera and some other species of the same genus.

Trehalose, sometimes called mycose, occurrs in ergot of rye and in Agaricus.

Maltose is a peculiar sugar obtained by treating starch paste with malt.

GLUCOSES.

The glucoses, of which common grape-sugar, or Dextrose, is the type, have the formula $C_6H_{12}O_6$.

They differ from the saccharoses in being **directly fermentable,** and in having the power to reduce **cupric** tartrate (in the alkaline volumetric solution, known as Fehling's) to **cuprous** oxide; manifested by the formation of a brick-red precipitate upon heating a mixture of these. The more important are:

Dextrose, or grape sugar	Galactose.
Levulose, or fruit "	Arabinose, and Inosite.

Dextrose, so-called because it rotates the plane of polarization to the **right,** is widely distributed in the vegetable kingdom, often occurring associated with cane, fruit and other sugars. It was first obtained from grapes, and hence is called **grape-sugar.** It is now manufactured on a large scale from Starch, by the action of Dilute Sulphuric Acid, dextrin being first produced, and then, by the continued action of the acid and heat, this is converted into glucose.

Commercial liquid Glucose is a dense syrup consisting of true glucose, maltose and dextrin in varying proportions with water. Besides being used somewhat in pharmacy to increase the body of syrups without producing a corresponding increase in sweetness, it is used extensively by brewers in the manufacture of sparkling ales, etc., and in the adulteration of table syrups.

Solid Glucose is in whitish, crystalline, anhydrous masses, much less sweet than cane sugar for which it is sometimes substituted.

Levulose is found associated with grape-sugar in fruits, and is commonly called fruit-sugar. It differs optically from dextrose or grape-sugar, by rotating the plane of polarization to the **left** instead of the right.

Galactose is derived from milk sugar by the action of dilute sulphuric acid.

Arabinose is obtained by boiling gum arabic in dilute sulphuric acid.

Inosite first found in muscles of animals, and hence is called muscle sugar.

Manna.—Manna, U. S.—The concrete saccharine exudation of Fraxinus Ornus, L., a species of Ash growing in Southern Europe. In flattish pieces, friable, externally yellowish-white, internally white, porous and crystalline, odor honey-like, taste sweet, slightly bitter and faintly acrid.

Mannite is prepared by dissolving manna in half its weight of boiling water, clarifying the solution with white of egg, filtering it while hot and crystallizing.

Uses.—A gentle laxative; an ingredient in Infusum Sennæ Comp.

Honey.—Mel, U. S.—A saccharine secretion deposited in the honey-comb by Apis mellifica, L., the Honey Bee.

Consisting of two kinds of sugar in nearly equal proportion, **dextrose,** the more solid portion prone to granulation and **levulose,** or fruit-sugar, the liquid portion.

A syrupy liquid of light-yellowish color, translucent when fresh, but gradually becoming opaque and crystalline, of an aromatic odor and a sweet, faintly acrid taste.

Purified Honey.—Mel Depuratum, U. S.—Honey in which the impurities have been removed by **coagulation** with heat, **clarification,** by straining through paper pulp, and **granulation prevented** by the addition of 5 per cent of Glycerin.

Uses.—As an excipient in masses and confections.

Off. Prep.—Mel Rosæ, containing 12 per cent Flext. of Rose.

GUMS.

The Gums are bodies closely related in their chemical structure to starch and cellulose, $C_6H_{10}O_5$, some containing an additional molecule of water. They are common vegetable products.

Exuding from many plants when the bark is punctured, they appear to perform the function of plugging up the wounded vessels and facilitating the healing process. These are produced, mostly at least, by the transformation of the cellulose or the substance of the cell-walls of plants.

Some are soluble in water, others only swell up but do not properly dissolve, and by reason of this difference they may be divided into two groups, only one representative of each, however, being official:

Acacia.—Acacia, U. S.—Gum Arabic.—A gummy exudation derived from Acacia Senegal. The greatest portion of a good quality of gum arabic consists of **arabin** or **arabic acid,** which may be prepared from the aqueous solution of the gum by acidulating it with chlorhydric acid and adding alcohol.

In roundish tears or angular fragments with a glass-like fracture, nearly inodorous, taste pleasantly acid, slowly soluble in 2 parts of water, forming a thick, viscid solution or mucilage; insoluble in alcohol. Its solution is **coagulated** by borax and also by lea subacetate solution into a light-yellow mass, and by ferric chloride into a reddish jelly; boiled for some time with dilute sulphuric acid, it is converted into glucose.

Uses.—It is employed extensively in the arts for a variety of purposes, as in the manufacture of **mucilage**, in the preparation of **water-colors**, in the preparation of **ink**, in order to hold in suspension the fine particles of tannate of iron; and in pharmacy it is used in the preparation of **emulsions**, **pill-masses**, **pastes**, **troches**, etc.

Off. Prep.—Mucilago Acaciæ, containing 34 per cent by weight; Mist. Glycyrrh, Comp.; Syrupus Acaciæ and the powdered in Pulvis Cretæ Compositus, Emulsions, Troches, Pills, etc., as an excipient.

Tragacanth.—Tragacantha, U. S.—Gum Tragacanth.—An exudation from the stem of Astragalus gummifer and other species of Astragalus. It consists largely of **bassorin**, which swells up but does not dissolve in water and is tinged blue by iodine.

In bands more or less curved, translucent, tough, rendered friable by heat.

Uses.—The Mucilage without the addition of glycerin as a **paste**, the Glycerite as an excipient, and the powder as a "binding medium" in many Mixtures and as an Emulsifying agent.

Off. Prep.—Mucilago Tragacanthæ, containing 6 per cent.

Cerasin, an exudation from cherry trees, resembles tragacanth.

DRUGS OF GROUP I.

In this group will be included Drugs which owe their value chiefly to Starch, Sugar or Gum.

Barley.—Hordei Fructus.—The seed of Hordeum distichum, L. Constituents: Starch, Gluten, etc. For preparing demulcent drinks.

Malt.—Maltum, U. S.—Seed of Hordeum distichum, Linne, caused to begin germination and then dried. Constituents: Dextrin, diastase, sugar, starch, etc. Preparation: Extractum Malti.

Diastase, a peculiar ferment, during the process of malting converts part of the starch into dextrin and sugar, and subsequently when the malt is "mashed," in brewing and in preparing malt extract, all the starch is converted into these compounds by the action of the diastase, which sets in at a certain temperature. Diastase is destroyed at a high temperature, hence the necessity of not exceeding 70°C, in the process of conversion.

Oat Meal.—Avenæ Farina.—The grain of Avena sativa, L., ground into a meal. Used for dietetic purposes, gruel, etc.

SACCHARINE DRUGS.

Corn Silk.—Zea, U. S.—The fresh styles and stigmas of Zea Mays, Linne, Indian Corn. Constituents: Sugar, fixed oil, resin, tannin and an acid. Prep.: Fluidextract.

Fig.—Ficus, U. S.—The fruit of Ficus Carica, Linne. Constituents: Sugar, gum, etc. Off. Prep.: Confectio Sennæ.

Prune.—Prunum, U. S.—Fruit of Prunus domestica, Linne. Constituents: Sugar, pectin, etc. Off. Prep.: Confectio Sennæ.

Triticum.—Triticum, U. S.—Couch Grass.—Rhizome of Agropyron repens, Linne. Constituents: Sugars, triticin (similar to inulin). Off. Prep.: Fluidextractum Tritici.

MUCILAGINOUS DRUGS.

Some of these drugs also contain a valuable fixed oil.

Sweet Almond.—Amygdala dulcis, U. S.—Seeds of Prunus Amygdalus, var. dulcis, De Candolle. Constituents: Fixed oil about 50 per cent, mucilage, sugar, etc. Off. Prep.: Emulsum Amygdalæ.

Uses.—For obtaining Oleum Amygdalæ Express: Emulsion, used as a vehicle for other substances; and as flour or paste for cosmetic preparations.

Althæa.—Althæa, U. S.—Marshmallow.—Root of Althæa officinalis, Linne. Constituents: Starch 37 per cent, mucilage, asparagin, etc. Prep.: Syrupus Althææ.

Uses.—Owing to the large proportion of starch it contains, preparations of althæa must always be prepared without the use of heat in the extraction (see infusion). The root occurs in commerce in the form of small cubes, and as such is largely used as an ingredient in **Species Pectorales,** N. F.; also for preparing a demulcent drink. The powder, owing to its absorbing qualities, is largely used in **pill-masses.**

Cetraria.—Cetraria, Iceland Moss.—Entire plant of Cetraria Islandica, Acharius. Constituents: Lichenin or lichen starch, 70 per cent, cetraric acid, etc. Prep.: Decoctum Cetrariæ.

Uses.—In the preparation of **Iceland moss jelly,** it is desirable to free the moss from the cetraric acid, to which the bitter taste is due, by macerating it in tepid water for half an hour, expressing the liquid which is rejected; and then exhausting the moss by boiling water, and straining. To the strained liquid sugar is added, and the mixture evaporated to jelly consistence.

Chondrus.—Chondrus, U. S.—Irish Moss.—Plant of Chondrus crispus, Lyngbye. Constituents: Mucilage, and traces of iodides, bromides, sulphates. Does not contain starch.

Uses.—Chiefly in the form of a **mucilage,** as an emulsifying agent. The decoction and Carrageen jelly are both prepared similarly to those from cetraria.

Cydonium.—Cydonium.—Quince seed, Seed of Cydonia vulgaris, Persoon. Constituents: Mucilage. Prep.: Mucilago Cydonii.

Uses.—Mostly as a demulcent in the form of mucilage; having but little adhesive power renders it sometimes preferable to tragacanth for hair dressing.

Elm.—Ulmus, U. S.—Slippery Elm.—Bark of Ulmus fulva, Michaux. Constituents: Mucilage. Off. Prep.: Mucilago Ulmi.

Uses.—As a demulcent, but chiefly for **poultices**, when it should be coarsely ground so that the mass will adhere together when moistened with water.

Flax Seed.—Linum, U. S.—Seeds of Linum usitatissimum, Linne. Constituents: Mucilage, fixed oil about 40 per cent.

Uses.—Ground flaxseed, "**Lini Farina**," for poultices. When deprived of oil, it is termed "**oil cake**," which is said to make an excellent cataplasm. From the whole seeds "**flaxseed tea**" is prepared, and with the addition of liquorice and a little lemon juice, furnishes a refreshing draught.

Sassafras Pith.—Sassafras medulla, U. S.—Pith of Sassafras variifolium, Kunze. Constituents: Mucilage. Off. Prep.: Mucilago Sassafras.

Uses.—In the preparation of Jackson's Pectoral Syrup; for **collyria**, and as a vehicle for more active remedies.

PRODUCTS OF FERMENTATION.

Starch and its derivatives, Albumen, etc., subjected to the effects of heat and water, in the presence of bodies called **ferments** undergo certain transformations by which their physical, as well as chemical, characters are more or less completely changed.

These so-called Ferments may be either **organized**, miscroscopic plants, such as the **Torula Cerevisiæ**, the common "Yeast plant;" the **Mycoderma aceti**, the "Vinegar plant;" or they may be simply **nitrogenized** or albuminoid substances called **Enzymes**, such as **Diastase** from Malted Grain or **Pepsin** and **Pancreatin** derived from Animals.

Since there are different Ferments, so there are also different kinds of **Fermentations**, viz.: The **saccharine** fermentation, in which Starch or Sugar is converted into **glucose**; the **alcoholic** or "vinous" fermentation, by which Glucose is converted into **Alcohol**, and the **Acetic** fermentation, by which Alcohol is converted first into Aldehyde and afterward into **Acetic Acid.**

There are, besides the **lactic, butyric** and other kinds of Fermentation, not to mention the more complex bodies, such as **Emulsin,** that produce so many wonderful phenomena in both animal and vegetable life.

The Alcoholic fermentation is of the greatest pharmaceutical interest and will be here considered.

THE ALCOHOLIC FERMENTATION.

As has already been stated, Starch, in the form of Corn or other grain, may be converted into glucose by heat and other

agencies. Glucose differs from the other kind of sugar, saccharose, chiefly in that it is **directly fermentable**. When, therefore, a **ferment** is added to glucose it is broken up into carbon dioxide and **Alcohol**, which may be obtained in a more or less pure form by distillation.

The steps in the process are as follows:

The grain, after being ground to a meal, is macerated with water at 88°C., known as the operation of "**mashing**," through which the Starch is changed into a soluble form, dextrose, etc., or **maltose**. Upon the addition of Malted Barley or Rye, the Maltose, at 60°C., is converted by the Diastase into **glucose**.

To this liquid, cooled to 18°C., Yeast is added, when the Glucose is broken up into Carbon Dioxide, which escapes, and **Alcohol** remaining in the liquid.

Other products are also formed at the same time, being chiefly alcohols of different chemical composition, such as **Amylic Alcohol** or Fusel Oil and **Propenyl Alcohol** or Glycerin.

These latter are much less volatile, that is, have a much higher boiling point, than the ordinary alcohol, which is obtained pure by fractional distillation.

Forms of Alcohol.

In the operation of recovering the Alcohol by distillation it may be obtained in various degrees of strength and purity.

High Wine or "Crude Whiskey" is the first distillate obtained, containing alcohol and water in nearly equal proportions. Its strength is designated by the number of degrees proof by the U. S. Internal Revenue Bureau; **two degrees proof** being equal to **one per cent by volume** of Absolute Alcohol.

Thus an alcohol of equal parts by volume of Absolute Alcohol and Water, at a temperature of 15.667°C. (60°F.) is 100 proof, and on this the tax to be paid is $1.10 for one U. S. Wine Gallon. An alcohol 188° proof contains, therefore, 94 per cent absolute alcohol, by volume.

The **strength** of alcohol is best determined by a Custom House **alcoholometer** and may readily be transcalculated into percentage by weight or specific gravity by reference to the alcohol Tables, p. 603, U. S. Ph. For the simplest method of reducing or increasing the strength of alcohol of various percentages, refer to rules U. S. Ph., p. 35.

Alcohol.—Alcohol, U. S.—A liquid composed of about 92.3 per cent by weight, or 94.9 per cent by volume, of Ethyl Alcohol, C_2H_5OH, and about 7.7 per cent by weight of Water; sp. gr. at 15°C. 0.816, or at 25°C. 0.809.

Obtained by fractional distillation from high wine or by direct distillation, separation of most of the water being effected by the use of upright or column condensers.

A transparent, colorless, mobile liquid of a characteristic agreeable odor and a burning taste. Miscible in all proportions with water, ether and chloroform. A ready solvent for most of the volatile oils, camphors, etc., resins and a great variety of organic and many inorganic compounds. Does

not dissolve nor mix with fixed oils or fats with a few exceptions. It boils at 78°C., is very inflammable, burning with a blue flame. Organic impurities are detected through coloration with silver nitrate solution. Alcohol should be kept in well-closed vessels remote from light or fire.

Uses.—As the most valuable and largely employed solvent, next to water; for preparing the three other official forms of alcohol and for producing many chemical compounds.

Dilute Alcohol.—Alcohol Dilutum, U. S.—A liquid composed of about 41.5 per cent by weight (48.9 % vol.) of Absolute Alcohol and 58.5 per cent by weight of Water; sp. gr. at 15°C. 0.936. Prepared by mixing equal volumes of Alcohol and Distilled Water.

In mixing alcohol and water a contraction occurs, which with equal volumes amounts to nearly 3 per cent in the mixed liquids.

Deodorized Alcohol.—Alcohol Deodoratum.—Cologne Spirit.—Was formerly official, but the present official alcohol has replaced it.

Absolute Alcohol.—C_2H_5OH.—Alcohol Absolutum, U. S.—Ethyl Alcohol containing not more than 1 per cent by weight of water; sp. gr. 0.800 (0.797) at 15°C. It is freed from water by rectification over Lime.

Very hygroscopic; it must be kept in tightly stoppered bottles in a cool place.

Uses.—As a chemical reagent and solvent.

Whisky.—Spiritus Frumenti, U. S.—An alcoholic liquid obtained by the distillation of the mash of fermented grain, usually mixtures of Indian corn, wheat and rye, and should be at least four years old.

Its sp. gr. should not be more than 0.945 nor less than 0.924, corresponding to an alcoholic strength of 37 to 47.5 per cent by weight (44 to 55% vol.). The distillate is colored by being allowed to stand in casks or barrels for a number of years, during which it undergoes changes that improve its quality. Whisky thus mellowed by age is called **old whisky**.

Other Alcohols.

Amyl Alcohol.—$C_5H_{11}OH$.—Or Fusel Oil—Obtained as a by-product in the fermentation of grain.

A thin, oily liquid, of an oppressive, penetrating odor, and an acrid, hot taste, boils at 132°C., sp. gr. 0.818. It is sparingly soluble in water, and freely so in alcohol, ether and benzol.

Uses.—Solvent for some of the alkaloids, source of valeric acid and of various compound ethers which are used in flavoring and in perfumery.

Propenyl Alcohol.—$(C_3H_5)3HO$—Glycerin.—Is treated under Fats.

ALCOHOL DERIVATIVES.

These comprise the Ethers, Aldehyde and its derivatives, Chloral and Chloroform.

THE ETHERS.

These ethers are the products of the action of Acids upon the Alcohols, and, as there are **series** of alcohols, so there are also of ethers. They bear the same relation to the alcohols that the **oxides of the metals** bear to **the hydrates.** For example:

$(C_2H_5)HO$ is ethyl alcohol, or ethyl hydrate, and $(C_2H_5)_2O$ is ether of ethyl oxide, so

$Na(HO)$ is sodium hydrate, and Na_2O is sodium oxide.

Ethers are of various kinds; some **simple,** as ethyl ether $(C_2H_5)_2O$; some **haloid,** that is, built on the plan of a molecule of common salt, as chlorhydric ether $(C_2H_5)Cl$; some **compound,** as

$$\text{acetic ether} \left\{ \begin{matrix} C_2H_5 \\ C_2H_3O \end{matrix} \right\} O.$$

There are also several other kinds, of less pharmaceutical interest.

The common ethers are liquid, highly volatile and inflammable, but there are others which are dense, non-volatile, or even solid at ordinary temperatures.

The ethers of most importance in pharmacy are:

Simple . .	methyl oxide, $(CH_3)_2O$, or methylic ether. ethyl oxide, $(C_2H_5)_2O$, or ethylic ether.
Haloid . .	Ethyl chloride, $(C_2H_5)Cl$, or chlorhydric ether. Ethyl bromide, $(C_2H_5)Br$, or bromhydric ether. Ethyl iodide, $(C_2H_5)I$, or iodohydric ether. ethylene bichloride, $(C_2H_4)\ Cl_2$, or Dutch liquid.
Compound . .	acetic ether, $(C_2H_5)\ (C_2H_3O_2)$, or ethyl acetate. formic ether, $(C_2H_5)(CHO)O$, or ethyl formate. nitrous ether, $(C_2H_5)\ NO_2$, or ethyl nitrite.

Ether.—Æther, U. S.—A liquid composed of 96 per cent by weight of absolute Ether or Ethyl Oxide $(C_2H_5)_2O$ and about 4 per cent of Alcohol containing a little water. It is produced by reaction upon Alcohol with Sulphuric Acid, the Ether being obtained by distillation. The name "**Sulphuric Ether**" was given to it erroneously.

A colorless, transparent, highly refractive, volatile and inflammable liquid, of a pleasant. penetrating odor, and sweetish pungent taste, sp. gr. 0.716, boiling point about 35.5°C. Its vapor mixed with air forms a **highly explosive** compound, and hence it should be handled with care and be kept in well-stoppered containers, remote from light or fire.

Spiritus Ætheris, U. S., contains 32.5 C.C. ether and 67.5 C.C of alcohol.

Spiritus Ætheris Compositus, U. S., or Hoffmann's Anodyne, the above with 2.5 C.C. of ethereal oil in 100 C.C.

This and the preceding spirit are used in medicine as stimulants, antispasmodics, and anodynes.

Uses.—The great value of ether in pharmacy depends on its

solvent power. It stands next to alcohol in this respect, and excels it as a solvent for certain oils and resins. In medicine its most important use is as an **anæsthetic.** It is safer and better than chloroform.

COMPOUND ETHERS.

Nitrous Ether, or Ethyl Nitrite [$NO.OC_2H_5$].—Formed along with other products when Alcohol is acted upon by Nitric Acid or Nitrites in the presence of sulphuric acid as a dehydrating agent:

(1) $NaNO_2+H_2SO_4=HNO_2+NaHSO_4$. and

(2) $C_2H_5OH+HNO_2=C_2H_5NO_2+H_2O$.

A mobile, colorless liquid, with a pecular pungent taste, and an odor resemblng apples.

Spirit of Nitrous Ether.—Spiritus Ætheris Nitrosi, U. S.—Sweet Spirit of Nitre.—An alcoholic solution of the above ether freshly prepared representing not less than 11 times its volume of Nitrogen Dioxide, NO, corresponding to about 4 per cent of Ethyl Nitrite.

A transparent, volatile, inflammable liquid with a pungent taste and a fruity odor; sp. gr. 0.823.

Uses.—As a diuretic and nervous stimulant.

Average Dose.—2cc. (30 minims).

Acetic Ether.—$CH_3CO.OC_2H_5$.—Æther Aceticus, U. S.—A liquid composed of 90 per cent by weight of Ethyl Acetate and about 10 per cent of Alcohol. It is produced by reacting upon Sodium Acetate with Sulphuric Acid in the presence of Alcohol and distilling.

A limpid, colorless, volatile liquid, having an ethereal, and somewhat acetous odor and taste; inflammable; sp. gr. 0.885, boils at about 76°C.

Uses.—Similar to those of ether. It is also valuable as a solvent for many fixed and volatile oils and resins; and as an addition to **perfumes.**

Methyl Salicylate.—$CH_3C_7H_5O_3$.—Methylis Salicylas, U. S.—An ester produced synthetically [$C_6H_4(OH)COOCH_3$], the principal constituent of Oil Gaultheria and Oil of Betula.

A colorless, slightly yellowish liquid having the characteristic odor and sweetish, aromatic, wintergreen taste. sp. gr. 1.185. It boils at 220°C. and is soluble in all proportions in alcohol, glacial acetic acid and carbon disulphide.

Uses.—As a substitute for Oil of Gaultheria, Oil of Betula for **Flavoring;** medicinally for the same purposes as the other salicylates.

Average Dose.—1 cc. (15 minims).

Ethyl Carbamate.—$C_3H_7NO_2$.—Æthylis Carbamas, U. S.—Urethane.—An ester of Carbamic Acid [$CO(OC_2H_5)NH_2$], pro-

duced by the reaction of Ethyl Alcohol on Urea (Carbamide) or one of its salts.

Scales or colorless crystals, without odor and of a cooling, saline taste. Soluble in less than its weight of water, alcohol, ether, readily in chloroform and glycerin.

Uses.—As a hypnotic similar to Hedonal, Euphorine and Veronal.

Average Dose.—1 Gm. (15 grains).

Ethyl Chloride.—C_2H_5Cl.—Æthylis Chloridum, U. S.—A haloid derivative monochlor. Ethane:—Prepared by the action of Hydrochloric Acid Gas on absolute Ethyl Alcohol.

A colorless, mobile, volatile and inflammable liquid; burning taste; boils at 13°C., sp. gr. 0.918 at 8°C.; should be kept in hermetically sealed glass tubes.

Uses.—To produce anesthesia by spraying.

Formic Ether.—(C_2H_5) (CHO)O, or Ethyl Formate, is produced by distillation of a mixture of Sodium Formate, Alcohol and Sulphuric Acid, the distillate being afterward rectified over calcium chloride.

A limpid, colorless, inflammable liquid, with an agreeable smell, suggesting that of peachkernels, and a pugnant taste. Sp. gr. 0.918, boils at 70°C.

Uses.—As a mild anæsthetic.

Methylic Ether.—$(CH_3)_2O$.—Obtained by action on Methylic Alcohol with Sulphuric Acid and distilling.

A colorless, volatile, inflammable liquid at the temperature of 20°C., but at higher temperature a gas which is freely soluble in water, ordinary ether, methyl alcohol, and alcohol. Like ordinary ether it has anæsthetic properties. Its uses in pharmacy are limited.

Ethylene Bi-Chloride.—$C_2H_4Cl_2$, is allied to the foregoing. It is commonly called "Dutch liquid," and is produced by the reaction of Chlorine gas upon olefiant gas.

A colorless, thin, oily liquid, with an odor like chloroform, a sweetish, pungent taste, inflammable, sp. gr. at 0°C., 1.27, boils at 85°C.

It has been used as an anæsthetic.

Ethyl Bromide.—C_2H_5Br, or Bromhydric Ether, is produced by the reaction of Bromine on Alcohol in the presence of phosphorus.

In physical properties it somewhat resembles ethyl chloride, but is denser, having a sp. gr. at 15°C. of 1.419; boiling point 40°C. It is also less readily inflammable.

Used as an anæsthetic, but the dangers attending its use are similar to those of chloroform.

Ethyl Iodide.—C_2H_5I, or Iodohydric Ether, is prepared by a method analogous to that adopted in the preparation of ethyl bromide.

A colorless, non-inflammable volatile liquid of a peculiar, penetrating odor; sp. gr. 1.93 at 15°C., boils at 72°C.

Used for its iodine, as an inhalant in pulmonary disorders; not anæsthetic.

Ethereal Oil.—Oleum Æthereum, U. S.—A liquid consisting of equal volumes of Heavy Oil of Wine and Ether; sp. gr. 0.905.

Produced by the reaction of Sulphuric Acid on Alcohol, distilling, washing and mixing the distillate with an equal volume of Ether.

Uses.—For preparing Spiritus Ætheris Compositus.

AMYL DERIVATIVES.

Amyl Nitrite.—$C_5H_{11}NO_2$.—Amylis Nitris, U. S.—A liquid containing 80 per cent of Amyl Nitrite, together with some other compounds. Produced by the action of Nitric or Nitrous Acid on Amylic Alcohol, the liquid distilled and purified washing and rectification.

A pale, yellow liquid of a peculiar, faintly ethereal odor and pungent, aromatic taste; sp. gr. 0.865 to 0.875. Almost insoluble in water, but miscible with alcohol or ether in all proportions. It volatilizes at ordinary temperature, is inflammable and must be kept in hermetically sealed glass-bulbs or glass-pearls, to be crushed in a handkerchief for inhalation.

Uses.—The vapors as an inhalant to increase the heart's action.

Average Dose.—0.2 cc. (3 minims).

Glyceryl Nitrate.—Glyceryl Nitrate or Nitroglycerin.—Obtained by reaction of Nitric Acid and Sulphuric Acid on Glycerin and Sulphuric Acid. **Explosive.** Official as

Spiritus Glycerylis Nitratis, U. S.—Spiritus Glonoini, U. S. '90.—An alcoholic solution containing one per cent by weight of Glyceryl Trinitrate $[C_3H_5(O.NO_2)_3]$.

Caution.—It must be kept carefully preserved against evaporation or loss and remote from lights or fire.

Uses.—As a peripheral vaso-dilator in solution or tablets.

Average Dose.—0.05 cc. (1 minim).

ALDEHYDE AND DERIVATIVES.

Aldehyde.—C_2H_4O.—Ethylic Aldehyde.—Produced by the oxidation of Alcohol by withdrawal of 2 atoms of H from C_2H_5OH, hence the name meaning Alcohol **de-hydrogenated.**

A colorless, mobile liquid, very inflammable, boils at 21°C., miscible with water, alcohol and ether in all proportions.

Paraldehyde.—$C_6H_{12}O_3$.—Paraldehydum, U. S.—A polymer of Acet-Aldehyde $[CH_3.COH]$.—Produced by the action of Chlorine on Ethylic Aldehyde until the latter is not soluble in an equal volume of water, when it is separated in a crystalline mass at the freezing point and afterward distilled.

A colorless liquid, boiling at 123°C., soluble in 8.5 parts water and miscible with alcohol, ether, fixed and volatile oils in all proportions.

Uses.—As a hypnotic in the form of pearls, **elixirs,** etc.

Average Dose.—2 cc. (30 minims).

Hydrated Chloral.—$C_2HCl_3O+H_2O$.—Chloralum Hydratum, U. S.—Chloral, U. S. '90.—A crystalline solid, composed of trichloraldehyde or Chloral with one molecule of water.

Obtained by action of dry Chlorine gas an **absolute** Alcohol, producing Aldehyde and HCl and by prolonged action of more Chlorine into Chloral. The solid mass thus obtained is treated

with sulphuric acid, when the chloral separates as an oily layer, which is purified by distillation over quicklime, and by addition of water is allowed to crystallize.

Rhomboidal, colorless and translucent crystal, having an aromatic, penetrating and slightly acrid odor and a bitterish, caustic taste; slowly volatilized when exposed to the air. Freely soluble in water, alcohol, ether, chloroform, benzol, benzin, fixed and volatile oils.

It **liquifies** camphor, menthol, thymol, phenol and their derivatives when triturated with them in about equal proportions.

Uses.—As a hypnotic, but is attended with some danger; as an overdose may produce fatal consequences, great care should be used in dispensing it, and only such samples as answer the Pharmacopœial tests for purity should be dispensed for internal use, namely, the **crystals.**

Average Dose.—1 Gm. (15 grains).

Hydrated Chloral is **incompatible** with alkalies and alkaline carbonates and compounds of Ammonium and Mercury.

Trichloracetic Acid.—$HC_2Cl_3O_2$.—Acidum Trichloraceticum, U. S.—A monobasic acid obtained by the oxidation of Hydrated Chloral with Nitric Acid.

Deliquescent white crystals of somewhat pungent odor. Very soluble in water, alcohol, ether, etc.

Uses.—As a Reagent; the solution (5 to 10 per cent) for removal of moles etc.; with caution.

Chloralformamide.—$C_3H_4ClNO_2$.—Chloralformamidum, U. S.—Chloralamid.—A crystalline solid [$CCl_3.CH(OH)NH.COH$], obtained by direct union of Formamide with Anhydrous Chloral.

Crystals without color or odor, of a slightly bitter taste. Soluble in 18.7 parts water, readily in alcohol, ether, etc.

Uses.—Hypnotic, similar to Chloral.

Average Dose.—1 Gm. (15 grains).

Chloroform.—$CHCl_3$.—Chloroformum, U. S.—A liquid consisting of 99 to 99.4 per cent by weight of absolute Chloroform and 1 to 0.6 per cent of Alcohol; sp. gr. 1.476.

Its molecule is like that of methyl hydride, CH_4, except that three of its hydrogen atoms are replaced by chlorine, and it belongs, therefore, chemically to the methyl series of compounds.

Produced by the action of Chlorinated Lime on Alcohol and distilling, also by the action of Caustic Soda on Chloral Hydrate. The reaction leaving out the intermediate steps is as follows:

$$2C_2H_5OH+10CaOCl_2=3CHCl_3+7CaCl_2+2CaCO_3+Ca(OH)_2+4H_2O$$

It is usually made by distilling Acetone with a mixture of Chlorinated Lime and Water, purifying the distillate with Sulphuric Acid, thoroughly washing it and distilling with a little Alcohol which aids in the preservation.

A heavy, clear, colorless liquid of a characteristic pleasant ethereal odor, a burning sweet taste and neutral reaction. It is soluble in about 200 times its volume of cold water and in all proportions in alcohol, ether, benzol, benzin, fixed and volatile oils. It is volatile at ordinary temperature, and boils at 60°C., but is **not inflammable.**

Tests.—When agitated with twice its volume of water, the latter should be (1) neutral to blue litmus-paper (absence of acids), (2) should not affect test-solution of silver nitrate (chlorides), nor (3) show coloration with Sulphuric Acid (organic impurities). No foreign odor should be noticed when a few drops are permitted to evaporate from a piece of blotting-paper. (For further tests see U. S. Ph.)

Uses.—Chiefly as an **anæsthetic.** It is doubtless less safe than ether, but most of the accidents that happen from its proper use as an anæsthetic may be attributed to the impure quality of the chloroform, and it cannot, therefore, be too strongly insisted upon that the tests of purity required by the Pharmacopœia be carefully applied to all chloroform sold for this purpose.

Average Dose.—0.3 cc. (5 minims).

Off. Prep.—Aqua Chloroformi; Emulsum Chloroformi; Linimentum Chloroformi; Spiritus Chloroformi.

Croton Chloral.—$C_4H_5Cl_3O$.—Butyl Chloral.—Trichlor-butyl-aldehyde.—By the action of Chlorine on Acetic Aldehyde, separation by distillation and hydration, as in making ordinary Chloral.

It differs from ordinary Chloral, chiefly in being sparingly soluble in water. Its medicinal properties are the same as of the ordinary Chloral, in about one-third the dose.

Iodoform.—CHI_3.—Tri-iodo-methane has been described under Iodine.

Bromoform.—$CHBr_3$.—Bromoformum, U. S.—A liquid consisting of 99 per cent by weight of absolute Bromoform and 1 per cent absolute Alcohol. Decomposes unless kept in amber-glass. Obtained by distilling a mixture of Chlorinated Lime, Potassium Bromide, Water and Acetone, similarly to the process for Chloroform.

A colorless liquid heavier than chloroform sp. gr. 2.808, which it otherwise resembles, sparingly soluble in water, readily in alcohol, ether, benzene, fixed and volatile dies.

Uses.—Anesthetic; in whooping cough, etc.

Average Dose.—0.2 cc. (3 minims).

Sulphonethylmethan.—$C_8H_{18}S_2O_4$.—Sulphonethylmethanum, U. S.—Trional - Diethylsulphonemethyl Ethylmethane [(CH_3)-$C_2H_5)C(SO_2C_2H_5)_2$], an oxidation product of Mercaptol, obtained by condensation of Methyl-ethylketone with Ethylmercaptan.

Crystalline scales without odor or color, of a **bitter** taste in aqueous solution; soluble in 195 parts water, readily in alcohol and ether.

Uses.—Hypnotic; in large amount of liquid, milk, beer, etc.

Average Dose.—1 Gm. (15 grains).

Sulphonmethane.—$C_{17}H_{16}S_2O_4$.—Sulphonmethanum, U. S.—Sulphonal - Diethylsulphonedimethylmethane [$(CH_3)_2C(SO_2C_2H_5)_2$], oxidation product of Mercaptol, obtained by condensation of Acetone with Ethylmercaptan.

Similar to the preceding, less soluble in water (360 parts); alcohol and ether contains also one ethyl group less and therefore is more depressant.

Uses and Dose.—Same as in the preceding.

WINES.

Wines are alcoholic liquids produced by the fermentation of fruit juices, chiefly those of the different species of the Grape, Vitis vinifera. They may be divided into **white** and **red** wines.

White wines are not usually colorless, but light-colored and are produced by the fermentation of the juice freed from seeds, stems and skins. **Red** wines are reddish in color, because the juice is derived from colored grapes and has been fermented with the "skins," consequently has taken up more or less of their coloring matter, and contains therefore more tannin than white wines.

Vinum Album, U. S., refers to any one of the numerous varieties of white wines of domestic production.

White wine should have a full, fruity, agreeable taste, without either excessive sweetness or acidity, and its odor should be agreeable and free from yeastiness. It should contain not less than 7 per cent, nor more than 12 per cent by weight of absolute alcohol, and its sp. gr. should be not less than 0.99 nor more than 1.01. Sherry, Madeira, Hock and Moselle are examples of imported white wines.

For pharmaceutical purposes, a wine stronger in alcohol is required, than can be prepared by simple fermentation, the highest thus obtained being 13.75 per cent by weight, or 17 per cent by volume. For this reason from 10 to 15 per cent of Alcohol is added to wine when it is used as a menstruum or solvent in the Medicated Wines. The greater proportion of alcohol prevents acetic fermentation, and thus better preserves the preparations.

Vinum Rubrum, U. S., refers to dry Red Wines of domestic production, such as Claret, Zinfandel and Burgundy. Claret and the various kinds of Port are examples of imported red wines.

Malt Liquors are made by the fermentation of infusions of malt to which hops have been added; they contain a smaller proportion of alcohol than wines. usually from 5 to 8 per cent.

Brandy.—Spiritus Vini Gallici, U. S.—An alcoholic liquid obtained by the distillation of the fermented, unmodified juice of fresh grapes, and at least four years old. Its sp. gr. should not be more than 0.941 nor less than 0.925, corresponding to an

alcoholic strength of 39 to 47 per cent by weight (46-55% vol.).

Brandy improves with age the same as whisky, the improvement in each case being chiefly due to the gradual chemical change and disappearance of the traces of fusel oil that could not be separated by fractional distillation.

From the Grape-juice indirectly the following is produced:

Tartaric Acid.—$H_2C_4H_4O_6$.—Acidum Tartaricum, U. S.—A dibasic acid found either free or in combination in the juices of many fruits—as grapes, tamarinds, sumach berries, pineapples, etc. Its principal commercial source is Cream of Tartar, which in turn is derived from the crude tartar or **Argol** that collects in the form of crystalline crusts on the sides of casks of fermenting wine.

Cream of Tartar is decomposed by Calcium Carbonate into Calcium Tartrate and the latter is decomposed by Sulphuric Acid setting the Tartaric Acid free, which is then obtained in a pure form by crystallization.

Colorless crystals of oblique rhombic prisms, not deliquescent, containing no water of crystallization, inodorous, intensely but agreeably sour, soluble in 0.71 parts of water and in 1.67 parts of alcohol, and in 250 parts of ether, nearly insoluble in chloroform and benzin.

Off. Prep.—Pulv. Effervescens comp.

Closely related to Tartaric Acid is Citric Acid, the two often occurring together in fruits.

Citric Acid.—$H_3C_6H_5O_7+H_2O$.—Acidum Citricum, U. S.—A tribasic acid, obtained chiefly from the juice of lemons and **limes.**

The juice is first clarified by boiling, and the clear liquid treated with Calcium Carbonate. From the Calcium Citrate thus formed the Citric Acid is liberated by treating it with Sulphuric Acid, and afterwards repeatedly crystallizing.

Colorless, transparent, right-rhombic prisms, of an agreeably acid taste, soluble in 0.54 parts of water and 0.4 parts of boiling water, in 1.08 parts of alcohol and in 18 parts of ether. If an aqueous solution of it be added to lime water it remains clear until boiled, when a white precipitate falls, which will nearly all be taken up when the liquid cools. Citric Acid is **distinguished from Tartaric Acid,** aside from its solubilities, in decomposing without emitting the odor of burning sugar when slowly ignited, and in not producing a precipitate with a solution of Potassium Acetate, upon the addition of alcohol.

Uses.—In making the Citrates and in the Liquor Magnesii Citratis and Liquor Potassii Citratis.

ACID SACCHARINE DRUGS.

This group, also called "refrigerant drugs," includes those drugs whose virtues chiefly depend on the presence of Sugar and such organic acids as citric, malic and tartaric acids. Many of them possess mildly laxative properties.

Cassia Fistula.—Cassia Fistula, U. S.—Fruit of Cassia Fistula, Linne. Constituents: Sugar, mucilage, pectin, fruit acids. Off. Prep.: Confectio Sennæ.

Uses.—The **pulp** is prepared by treating the cassia with water, freeing the mixture from the seeds and woody portion by straining and evaporating the liquid; yield, about 30 per cent.

Lemon Juice.—Limonis Succus, U. S.—Fresh juice of ripe fruit of Citrus Limonum, Risso. Constituents: Citric acid from 7 to 10 per cent. malic acid, sugar and gum. Preparations, U. S. Ph., '80; Misura Potassii Citratis; Syrupus Limonis.

Lemon juice is liable to become moldy or otherwise unfit for use. It may be prepared by precipitating the gum by the addition to the juice of one-half its weight of alcohol, the clear portion heated to expel the alcohol, and bottled while hot.

Raspberry.—Rubus Idæus, U. S. '90.—Fruit of Rubus Idæus, Linne. Constituents: Sugar, citric and malic acids, pectin, glucose, trace of volatile oil, coloring matters. Prep.: Syrupus Rubi Idæi.

Uses.—In the preparation of Raspberry Syrup, the crushed berries are allowed to stand for about 36 hours, so as to undergo a slight fermentation. The expressed juice is clarified by standing, filtered and the Sugar dissolved in the filtrate by heat. The Syrup is brought to the boiling point, strained, bottled while hot and kept in a cool place.

Tamarinds.—Tamarindus, U. S.—Preserved pulp of fruit of Tamarindus Indica, Linne. Constituents: Citrates, malates, tartrates, acetates; also sugar, pectin, tannin. Off. Prep,: Confectio Sennæ.

Uses.—The **pulp** is prepared by treating tamarinds, with water, expressing and straining the expressed liquid, then evaporating to the consistence of a pulp, or a very soft extract.

Rhus Glabra.—Rhus glabra, U. S.—Smooth Sumach. Fruit of Rhus glabra, Linne. Constituents: Acid calcium and potassium malates, tannin, coloring matter. Off. Prep.: Fluidextractum Rhois Glabræ.

QUESTIONS ON LECTURE VII.—SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink,** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all the **rules** of the "Important Notice" must be complied with. **The Director.**

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1. What is Cotton **botanically?** What is it **chemically?** What are its principal Uses?

2. Upon what **property** of Cotton does these uses depend? What is the **purpose** of the purification of Cotton?

3. What is Pyroxylin **chemically?** How does it differ from other Nitro-cellulins? What **class** of preparations is made from it?

4. How is Collodion made? (b) Name the **official** Collodions.

5. How is Oxalic Acid made on the commercial scale? State its chemical Formula and its use in the U. S. Ph.; also its **antidote.** What household remedy does it resemble?

6. From what is "Pyroligneous acid" derived? Name its 3 **principal** constituents.

7. Give the Chemical Formula for Acetic Acid and the percentage **strengths** of 4 forms of it.

8. What is Acetone **chemically?** Give Chemical Formula and chief **commercial** use.

9. What official **preparations** are made from Tar, and what official **product** is obtained by its distillation?

10. Define Creosote. Give its **source,** chemical constitution, and physical and chemical properties.

11. What was the U. S. '90 **name** for Phenol? (b) Name official **forms.** (c) Give dose and antidote.

12. How is Salicylic Acid made **Synthetically?** From what is it made **Chemically?** What is its characteristic **color** reaction?

13. Name the official **Compound** of Salicylic Acid and Phenol. (b) Give its therapeutic action and dose.

14. What is "Columbian Spirits?" (b) What is "Methylated Spirit?"

15. What is Oil Mirbane? how made and how may Anilin and Acetanilide be successively made from it? Give **dose** of Acetanilide.

16. What is the **common** or trade name for Diethylsulphonedimethymethane? (b) What is its use and dose?

17. How does Diethylsulphonemethylethylmethane **differ** from the above in name and solubility?

18. How do Benzin and Benzene differ in **derivation,** in chemical constitution and in properties?

19. What official semi-liquid **products** are obtained from Petroleum?

20. Give the Latin title for Starch. (b) What is the source of the official variety and name the **official preparation.**

21. Mention the **sources** of official Sugar. (b) Name the two general **groups** of Sugars.

22. How do Glucoses **differ** from Saccharoses, and what chemical **test** is employed to distinguish between the two?

23. Mention the official Gums, and their chief **constituents.**

24. In what three **forms** is Ethyl Hydrate official? State **percentage** strength of each.

25. What is Sulphuric Ether? Hoffman's Anodyne?

26. Give the chemical formula, mode of preparation and of **purification** of Chloroform.

27. Give official title for **Chloral.** (b) How made and purified?

28. How does Chloral **act** upon Camphor, Thymol and Menthol?

29. How and from **what** is Wine prepared?

30. How and from **what** are Whisky and Brandy prepared? What should be their respective Alcoholic **strength** and **age?**

31. State the chemical formula of Tartaric Acid, its **basicity,** and its official **preparations,** if any.

32. How is Citric Acid prepared, and how may it be **distinguished** from Tartaric Acid?

33. Give Latin title for **Purified Honey** and what advantage has it over the **Crude Honey?**

34. How does Resorcin differ from other coal-tar product **physically?**

THE FIXED OILS AND FATS.

The Fatty Oils constitute a distinct natural group of ternary compounds, and are found widely distributed in both the animal and vegetable kingdoms, few animals or plants being entirely destitute of them. In the higher **Animals** they are mainly stored beneath the skin in the connective tissue, in the abdominal cavity about the Kidneys, etc. In **Plants** they often constitute a considerable portion of the weight of Seeds and Fruits, but are found in other parts of the plant. In both kingdoms they serve mainly as reserve stores of **Food.**

They are either liquid, semi-liquid or solid at ordinary temperatures; **greasy** to the feel when sufficiently fluid, they are **lighter** than water, and do not **mix** with it in any proportion, are, with two exceptions, but **slightly soluble** in Alcohol, while they are **freely soluble** in Ether, Chloroform, Carbon Disulphide, Petroleum-Benzin and the Volatile Oils; they are **not volatilizable without chemical change** and leave a **greasy** stain upon paper when heated, but at a temperature varying between 260° and 315°C. they boil, giving off irritating vapors, and they saponify, or when treated with alkali, form **soaps.**

The fixed oils are all **combustible,** burning with a smoky flame. Some remain unchanged for a long time when exposed to the air, while others, especially those that contain mucilaginous or proteid impurities, undergo change and become **rancid,** while still others gradually harden, lose their unctuous feel, and become tough, flexible and varnish-like. These last are called **drying** oils.

Chemically considered, the fixed oils are mixtures, in various proportions, of two or more principles. The most important of these are:

Olein, Stearin Palmitin, Myristin and Laurin.

There are several modifications of Olein, also many others of minor importance such as Butyrin.

These are regarded as **ethereal salts,** compounds of the radical Glyceryl and acids of the Oleic and Fatty Acid series, which combine with alkalies to form soaps, while the liberated Glyceryl combines with OH to become Glyceryl Hydrate or **Glycerin.**

Of these principles Olein remains liquid at ordinary temperatures; Palmitin congeals at the freezing point, while Stearin is a solid which melts only at a temperature of about 60°C. (140°F.)

Thus fats consisting chiefly of Olein, being usually liquid, are commonly called "**Oils**," in distinction to the "**Fats**" which may be semi-solid like **Lard**—a mixture of nearly equal parts of Olein and Stearin—or solid like **Suet**, which consists chiefly of Stearin.

Preparation.

Animal fats are prepared from the tissues by **melting** them, either alone or in the presence of water, and separating the fused fat from the tissue by straining.

The fixed oils from vegetable structures are usually separated from the containing tissues by **expression**; sometimes by **extraction** with a volatile solvent, such as Petroleum-Benzin, Ether or Chloroform.

The material is usually ground, and then pressed, either cold or between metallic surfaces heated to a temperature a little above that of the melting point of the oil. Inferior oils are obtained by boiling the material in the presence of water, and separating the refuse solid matter by straining.

Adulterations.

These are chiefly mixtures of the rarer and more expensive kind with common and cheaper ones, and on account of the resemblance in composition, the fraud is difficult to detect.

The principal means of detection are by the **odor** when warmed, and by their behavior to certain reagents, **color** reactions with acids, and such oxidizing agents as Silver Nitrate.

Few oils are nearly odorless, most of them having a more or less characteristic odor, which, by carefully comparing a sample of a suspected product with one of known purity, may serve to distinguish them. As the fixed oils do not differ widely in their densities, they cannot be identified through their specific gravities.

The determination of the **boiling point** only serve to ascertain admixture of volatile oils.

The presence of **fish oil** as an adulterant of any of the vegetable oils may readily be detected by passing a current of Chlorine gas through the oil. No change of color will occur if pure, but in the presence of Fish Oil, the mixture will turn **dark**.

Another test applicable in a few cases is the **sulphuric acid** test. If ten parts of the oil be heated with one of Sulphuric Acid, different **colorations** will be produced, which will depend upon the nature of the oil. For instance, Oil of Black Mustard will be changed to a **bluish green**, Linseed Oil will turn **dark brown**, and Fish Oil will assume a **reddish** color.

The **identity** and purity of fats may be determined by:

The Saponification Value; that is, the number of cc. alcoholic Potassium Hydroxide Test Solution required to neutralize a certain quantity of the oil. See Test 99; p. 536, U. S. Ph.

The Iodine Absorption Value is the figure which indicates the percentage of Iodine absorbed under certain conditions. See Test 51; p. 527, U. S. Ph.

Purification and Preservation.

As has already been stated the presence of mucilaginous and proteid compounds in oils tends to produce rancidity.

These impurities may be removed by filtration or by the introduction of some reagents that destroys them. With small quantities the oil is filtered through perfectly dry filter-paper; a water-bath being used if the oil is viscid.

With considerable quantities, 1 to 2% Sulphuric Acid is gradually added to the oil, which carbonizes the impurities, and after separating the acid by repeated agitation with water, are gotten rid of by filtration.

As many fixed oils undergo gradual change, when exposed to heat, light and air, they should be kept in closed vessels, and in a **cool** place.

Classification.

The Fixed Oils may be classified as follows:

I. Those which yield glycerin—

(1) Liquid fats.

a. Drying Oils: Flaxseed, Hemp, Nut and Poppy Oils.

b. Non-Drying Oils: Vegetable—Olive, Almond, Colza, and Rape.
Animal—Lard, Tallow and Neatsfoot Oils.

c. Intermediate Oils partaking partly of the characters of both.
Fish Oils.
Cotton Seed Oil Group.
Castor Oil Group.

(2) Solid fats.

d. Inodorous: Lard and Suet.

f. Odorous: Nutmeg Laurel, Palm, Cacao, Cocoanut Oils and Butter.

Waxes and Wool Fat are sometimes classed with Fats but they yield no Glycerin.

These Groups will be considered in their order.

LIQUID FATS.

Liquid Fats comprise those which are liquid at **ordinary** temperatures, but may become solid or partly so at a **low** temperature. By reducing the temperature one of the principles solidifies before the other, and hence may often, by this means be separated.

The Drying Oils.

These are all derived from the **vegetable** kingdom and are distinguished from the other oils by the fact that by **exposure to the air** they are gradually converted into tough, flexible, var-

nish-like masses. They are **not solidified** by Nitrous Acid. One only is official:

Flaxseed Oil.—Oleum Lini, U. S.—Linseed Oil.—Obtained by pressure from seeds of Linum usitatissimum without the use of heat.

Color, yellow, or if obtained by hot pressure, darker. Odor, slight. Taste, bland. Sp. gr. 0.925 to 0.935 does not congeal above—20°C. Composed of palmitin, myristin and linolein, mainly.

Uses.—As demulcent; externally, as protective; mixed with Lime water as a dressing for burns, "**Carron Oil.**"

Off. Prep.—Linimentum Calcis; Sapo Mollis; Liquor Cresolis Comp.

Oil of Hemp.—Oleum Cannabis.—Obtained by pressure from crushed fruit of Cannabis sativa.

Color, green, changing to light brown on exposure. Odor, disagreeable. Taste, mild. Sp. gr. 0.930. Solidifies at about—15°C. Composed of palmitin, linolein, and possibly other oils.

Uses.—As demulcent and protective.

Nut Oil.—Oleum Juglandis.—Obtained by pressure from the seeds of various species of Juglans.

Color, greenish or none. Odor, faint. Taste, bland, nut-like. Sp. gr. 0.92. Solidifies at about—18°C. Contains probably linolein with other fixed oils.

Uses.—As a demulcent and protective.

Poppy-Seed Oil.—Oleum Papaveris.—Obtained by pressure from the crushed seeds of Papaver somniferum.

Color, light yellow. Odor, slight. Taste, bland. Sp. gr. 0.92. Solidifies at—18°C. Contains linolein, palmitin, and probably other fixed oils.

Uses.—Protective, demulcent.

The Non-Drying Oils.

These oils do **not solidify** on exposure to the air but are characterized by the fact that they become **solidified** when treated with Nitrous Acid. As a group also they are **less** fluid than the drying oils.

They may be subdivided into two kinds: Those of **vegetable** and those of **animal** origin.

To the former belong the oils of:

Olive,	**Almond,**	Colza,
Mustard,	Rape,	Earth-nut.

And to the animal oils:

Lard Oil, Neatsfoot, Tallow and Bone Oil.

The most important of the **vegetable** oils are:

Olive Oil.—Oleum Olivæ, U. S.—Obtained from the fruit of Olea Europæa; the best quality, or **virgin** oil, by cold pressure of crushed ripe fruit; a second quality, known as **Malaga Oil,** from the unripe fruit. By mixing the residue with hot water,

and expressing and also from decayed material, the **inferior** qualities of oil are obtained.

Color, yellow or greenish yellow. Odor, faint, agreeable. Taste, bland. Sp. gr. 0.910 to 0.915. Crystalline deposit at 10°C., and at 0°C. forms a whitish, granular mass. Contains chiefly olein, also small quantities of palmitin, cholesterin, arachin, and probably stearin.

Largely adulterated with Cotton seed and other cheap oils whose presence may be detected by the **solidification** with Mercuric Nitrate, or the **coloration** produced by warming with an alcoholic solution Silver Nitrate. See U. S. Ph.

Uses.—As lenitive, demulcent, and in **Ointments.**

Dose.—30 cc. (1 fl. oz.)

Off. Prep.—Unguentum Diachylon.

Oil of Almond.—Oleum Amygdalæ Expressum, U. S.—Obtained by expression from Bitter or Sweet Almond.

Color, yellowish. Odor, faint, nutty. Taste, bland. Sp. gr. 0.910 to 0.915; should remain clear at—10°C and congeals at about—20°C. Contains olein and a little palmitin.

Oils expressed from **peach** and **apricot** kernels resemble almond oil, but when these are mixed with an equal bulk of Nitric Acid, sp. gr. 1.16, and heated to 65°C., they turn yellow or orange, while almond oil is not colored.

Uses.—As lenitive and demulcent.

Dose.—30 cc. (1 fl. oz.)

Off. Prep.—Unguentum Aquæ Rosæ.

The most important **animal** non-drying oils are:

Lard Oil.—Oleum Adipis, U. S.—Obtained from **Lard**, by expression at a low temperature.

Nearly odorless, colorless and tasteless. Sp. gr. 0.905 to 0.915; deposits granules at 10°C.; at 0°C. forms a solid white mass. Contains olein, stearin and some palmitin.

Neatsfoot Oil.—Oleum Bubulum.—Obtained by boiling with water the fatty tissue of neatsfeet and straining.

Little odor or taste. Sp. gr. 0.915. Solid fats begin to separate at 0°C. Contains oleum and solid fatty bodies.

Uses.—Mostly externally.

INTERMEDIATE OILS.

Oils partaking partly of the characters of both Drying and Non-Drying Oils. This is a miscellaneous group, comprising oils both of **animal** and **vegetable** origin, most of which **thicken** but do not solidify on exposure. They agree in becoming more or less thickened, but in **not solidifying** when treated with Nitrous Acid.

They are divisible into three distinct sub-groups, as follows:

(1) The Fish Oils; (2) the Cotton-Seed Oil group; (3) the Castor Oil group.

The **Fish Oils** include:

Cod Oil, Cod Liver Oil, Hake Oil, Sperm Oil, Porpoise Oil, Shark Oil and various others.

Their consistence is changed but little on exposure to the air; they turn **brown** with Chlorine; are **reddened** by boiling with caustic Alkali; are but **little** thickened on treatment with Nitrous Acid, and have a more or less disagreeable **fishy** odor.

Cod Liver Oil.—Oleum Morrhuæ, U. S.—Obtained by cold expression from the livers of Gadus Morrhua and other species of the same genus, and preserved from contact with the **air.**

Color, light yellow. Odor, fishy. Taste, disagreeable. Sp. gr. 0.918 to 0.922. Should separate very little or no solid fat at 0°C. Contains olein, palmitin, stearin, and minute quantities of iodine, bromine, biliary compounds, etc.

Uses.—Alterative, demulcent, nutritive. The inferior oils are amber-colored or brownish, of a more disagreeable odor and taste, and they deposit crystalline matter at a temperature higher than 0°C.

The following emulsions are official:

Emulsum Olei Morrhuæ, U. S.—

Emulsum Olei Morrhuæ cum Hypophosphitibus, U. S.—

The remaining oils of this group are of but little value in pharmacy; they are chiefly employed as **lubricating media.**

The **Cotton-seed Oil** group includes:

Cotton-seed Oil, Sesami Oil, Beech-nut Oil, Sunflower Oil and some others.

Their **viscosity** is considerably increased by exposure to the air; they are considerably **thickened** by the action of Nitrous Acid, and they are mostly bland to the taste, and nearly odorless.

Cotton-Seed Oil.—Oleum Gossypii Seminis, U. S.—Obtained by pressure from seeds of Gossypium herbaceum. The crude oil is purified by treating it dilute Alkali solutions and bleaching.

Color, yellowish. Odor, slight. Taste, sweetish, similar to that of almond oil. Sp. gr. 0.915 to 0.921. Solidifies at 0°C., or a little below. Contains olein, palmitin, and yellow coloring matter.

Uses.—As a demulcent.

Off. Prep.—Linimentum Ammoniæ; L. Camphoræ.

Benne Oil.—Oleum Sesami, U. S. '90—Teel Oil.—Obtained by pressure from the crushed seeds of Sesamum Indicum.

Color, transparent, yellow. Odor, little or none. Taste, bland. Sp. gr. 0.92. Solidifies at about 5°C., or a little above. Contains olein, palmitin, stearin, and myristin. Uses, as a demulcent. Test, turns red-brown when treated with a mixture of a cold nitric and sulphuric acids.

The remaining oils of this group, in common with other oils possessing similar properties, such as the oil of the **Peanut**, etc., are used for **domestic** and **culinary** purposes. Their employment in pharmacy, however, is comparatively rare.

The **Castor Oil** group include Castor Oil and Croton Oil.

They are somewhat denser and more **viscid** than the other oils behave similar to them as regards exposure to the air and Nitrous Acid, but differ from all the other oils in being **soluble** in Alcohol, and in possessing strongly **purgative** properties.

Castor Oil.—Oleum Ricini, U. S.—Obtained from the seeds of Ricinus communis. That obtained by **cold** pressure is the best. It is purified by agitating with warm water, and decanting the oil.

Colorless. Odorless. Taste, nauseous, slightly acrid. Sp. gr. 0.945 to 0.965. Thickens at 0°C. and at 18°C. congeals to a yellowish mass. Soluble in an equal volume of alcohol. Consists of ricinolein, palmitin, and an acrid principle.

Croton Oil.—Oleum Tiglii, U. S.—Obtained by pressure from the seeds of Croton Tiglium, or by extraction with a solvent.

Color, yellowish or brownish. Odor, slight, peculiar. Taste, very acrid. Sp. gr. 0.935 to 0.950. Soluble when fresh in 60 parts of alcohol, but its solubility increases with age. Contains palmitin, stearin, laurin, myristin, various odorous oils, as glycerides of valeric and butyric acids; and also tiglinic acid and crotonol.

Uses.—As an **irritant**, rubefacient and sometimes **internally as a drastic** purgative.

Dose.—0.05 cc. (1 minim); exceedingly **poisonous.**

THE SOLID FATS.

Under these are included all those Fatty substances which remain **solid** at ordinary temperatures. As already observed their consistence depends upon the relative proportion of the various constituents they contain Stearin, Olein, palmitin, myristin, laurin, etc. Some are of **vegetable** and others of **animal** origin and they may be divided into two groups viz.: Vegetable and Animal Fats.

The **vegetable** fats all contain either a **volatile oil** or some other **odorous** substance; they comprise one official:

Cacao Butter.—Oleum Theobromatis, U. S.—Obtained by expression from the roasted seeds of Theobroma Cacao. Derived as a by-product in the manufacture of Chocolate.

Color, yellowish, changing to white on exposure. Hard. Odor, aromatic. Taste, similar to chocolate. Sp. gr. 0.97. Melts at 30°C to 35°C. to a clear liquid. Contains olein, stearin, palmitin, arachin, and laurin.

Uses.—As a vehicle for **Suppositories** and Ointments. Demulcent.

Cocoanut Oil.—Oleum Cocos.—Obtained from the seeds of Cocos nucifera, by boiling in water and applying hot pressure.

Color, white. Consistence of butter. Odor, peculiar. Taste, bland (but rapidly becomes rancid, when both odor and taste are disagreeable). Melting point from 22°C. to 28°C. Contains laurin, palmitin, stearin, myristin; also glycerides of caprinic, caprylic, and capronic acids.

Uses.—In Cold Creams, Skin Foods, etc.

Expressed Oil of Nutmeg.—Oleum Myristicæ Expressum.—Obtained by hot pressure from the seeds of Myristica fragrans.

Color, yellowish or whitish, mottled with orange-brown. Odor, aromatic. Taste, spicy. Sp. gr. 0.995. Melts at about 45°C. Soluble in four times its weight of strong alcohol. Contains, besides volatile oil, myristin, myristic acid and coloring matter.

Uses.—Stimulant, caminative.

Laurel Oil.—Oleum Lauri.—Obtained by steeping the fruit of Laurus nobilis in hot water and subjecting it to hot pressure.

Color, greenish. Consistence, semi-solid, granular. Odor and taste, aromatic, spicy. Melts at about 40°C. Contains volatile oil, laurin and other fat substances.

Uses.—In **Ointments**, etc. Stimulant and nervine.

Palm Oil.—Oleum Palmæ.—Obtained by heating the fruit of Elais Guiniensis with hot water and then subjecting it to hot pressure.

Color, orange red, but bleached by exposure to light. Odor, pleasant. Taste, bland. Melts at 27°C. Rapidly becomes rancid on exposure. Contains olein, palmitin, and a coloring principle.

Uses.—Mainly for **soaps**, sometimes as a demulcent.

The principal solid **Animal** fats are:

Lard.—Adeps, U. S.—Obtained from the fatty tissues of the Hog, Sus scrofa, by expression and straining.

Color, white. Consistence, soft. Taste, bland. Sp. gr. 0.917. Melts at 38° to 40°C. (100°F.) to a liquid.

Uses.—As a vehicle for **Ointments** and **Cerates.**

Adeps Benzoinatus, U. S.—Benzoinated Lard.—Prepared by digesting Lard with 2% of powdered Benzoin and straining. For use in hot weather, 5% of **wax** may be added.

Prepared Suet.—Sevum Preparatum, U. S.—Obtained from the fatty tissues of the abdomen of the Sheep, Ovis aries, by expression and straining.

Color, white. Consistence, hard. Taste, bland. Melts at about 45°C. Contains olein and palmitin, but chiefly stearin. That from the **Ox** is similar in its properties.

Uses.—In the preparation of **Cerates.**

Wool-Fat.—Adeps Lanæ, U. S.—The Purified Wool of the Sheep freed from water or **anhydrous.**

Constituents—Chiefly Cholesterin, which does not saponify and yields no glycerin.

Hydrous Wool-Fat.—Adeps Lanæ Hydrosus, U. S.—Lanolin. Wool-Fat mixed with not more than 30% of water, which it has

the power to absorb, furnishing a mixture of ointment-like consistence.

Color, white. Consistence nearly hard. Melts at 40°C. **Contains** chiefly cholesterin, chemically an alcohol not yielding glycerin.

Uses.—As a vehicle in many official **Ointments** for endermic **medication,** that is, when systemic effect is desired.

Butter.—Butyrum.—Obtained by churning the cream of cow's **Milk.**

Color, yellow. Consistency, rather soft. Odor, pleasant, peculiar, but when rancid, disagreeable, owing to the presence of butyric acid. Taste agreeable, bland. Melts at about 28°C. Contains olein, palmitin, stearin, small quantities of glycerides of butyric, caprylic, capronic and caprinic acids.

Uses.—As a demulcent and sometimes in Ointments. For pharmaceutical uses should be fresh, **unsalted,** and free from casein.

THE WAXES.

The second of the two principal divisions of the Fats consist of those which yield no **glycerin,** but instead a complex monatomic alcohol. They are called **Waxes,** and are **solid** at ordinary temperatures.

They include: Bees' wax, Spermaceti and Chinese, Brazil Myrtle and Palm and some other waxes.

The most important, pharmaceutically, are:

Yellow Wax.—Cera Flava, U. S.—Obtained by melting the Honeycomb in hot water, separating and straining the wax.

Color, yellow. Odor, somewhat aromatic, honey-like. Nearly tasteless. Melts at about 64°C. Spr. gr. 0.96. Contains cerin, myricin, aromatic and coloring matters.

White Wax.—Cera Alba, U. S.—Is prepared from the yellow wax by bleaching it by exposure to light.

Wax is often **adulterated** with tallow or paraffin. Tallow is detected by its lower sp. gr., and by the fact that the mixture is softer than pure wax. Paraffin is best detected by heating one part of the suspected wax with five of Sulphuric Acid to 160°C., and diluting the mixture with water, when paraffin, is present, will separate.

Uses.—In **Cerates,** Plasters and Ointments mainly.

Spermaceti.—Cetaceum, U. S.—Obtained from deposits in cavities in the head of the Sperm-Whale, Physeter macrocephalus.

Color, white, translucent. Consistence, hard, crystalline. Without odor or taste. Sp. gr. about 0.94. Melts at about 50°C. Composed chiefly of cetin.

Uses.—In **Ointments** and **Cerates.**

Petroleum Ointment.—Petrolatum, U. S.—Sometimes classed with the **waxes** because of it containing Paraffin; was treated of under Petroleum.

OILY DRUGS, GROUP III.

This Group includes a few Drugs whose chief value in pharmacy is due to a **bland** Fixed Oil they contain, usually asso-

ciated with gum or mucilage as in the case of Almond and Flaxseed.

These drugs were treated with the Mucilaginous Drugs of Group 1.

The only other official is:

Lycopodium.—Lycopodium, U. S.—Spores of Lycopodium clavatum, L., and other species of Lycopodium. Nat. Ord., Lycopodiaceæ. Constituents: Fixed oil 47 per cent.

Uses.—As a protective for raw and inflamed surfaces. Also as a "**dusting powder**" for pills. It is combustible, burning with a fine rose-colored flame, and is largely used in **pyrotechnics.** It should be kept remote from light and fire.

To this Group belong the parts of plants whence are derived the **Oils,** viz.: The **fruits** of Olive, Laurel and Palm; the seeds of the Cotton plant, Sesami, Sunflower, Poppy; the various **Nuts,** Butternut, Peanut, Beech and Cocoanut; the **seeds** of Cacao, and those that furnish the Castor and Croton oils.

DERIVATIVES OF FATS.

Soaps.

When fats or oils are mixed with salifiable bases the principles which they contain, viz.: Olein, Palmitin and Stearin, etc., are decomposed into their respective acids, **oleic, palmitic** and **stearic** acids, which unite with the base forming **soap.**

The liberated radical Glyceryl combines with OH and becomes Glyceryl Hydrate or Glycerin which separates. Glycerin is therefore a by-product in soap-making.

Soaps, therefore, chemically considered are **salts,** and consist of **oleates, palmitates** and **stearates** of the respective bases, according to the presence of the several principles in the fats.

Soaps may be divided into two classes:

(1) Soluble soaps. (2) Insoluble soaps.

Soluble Soaps comprise those made with Soda and Potassa and are respectively termed **hard** and **soft** soap. The finest Soap is made from Olive Oil and is sold under the name of Castile Soap, which furnishes the base for the finely perfumed toilet Soaps.

Soap.—Sapo, U. S.—White Castile Soap.—Prepared from Sodium Hydroxide and Olive Oil.

When dried to a constant weight at a temperature of 110°C., it should not lose more than 36% of its weight (water).

Off. Prep.—Emplastrum Saponis; Linimentum Saponis.

Soft Soap.—Sapo Mollis, U. S.—Sapo viridis, Green Soap, U. S. Ph., '80. Prepared by heating 40 Gm. Linseed Oil with 9.5 Gm. Potassium Hydroxide in 40 C.C. of Water and adding 4

C.C. Alcohol and boiling until the mixture is completely soluble in boiling water.

Off. Prep.—Linimentum Saponis Mollis.

OLEATES.

Insoluble Soaps or Oleates, as they are also **termed,** are formed by combining the fat acid with an Earth or **metallic oxide, i. e.,** Mercury, Lead, Zinc, or **Alkaloid** Bases. If made by interaction with Castile Soap they are not pure oleates but mixtures of **oleates** and **palmitates.** They are either dry **powders** or of the consistence of cerates.

Uses.—In various **skin** affections.

Of this class there is only one official:

Lead Plaster.—Emplastrum Plumbi, U. S.—Diachylon Plaster.—Made by interaction of Lead acetate 60 Gm. in 250 **c.c.** hot water and a hot solution of Soap, dried, 100 Gm. in Water 350 c.c., washing, collecting and drying the precipitated Oleate by working it with a spatula on a hot tile.

Emplastrum Adhesivum, U. S.—Rubber 2 Gm., dissolved by heat in Petrolatum 2 Gm. and Lead Plaster to 100 Gm.

Uses.—As vehicle for Plasters.

The class of Official Oleates are solutions of oleates in Oleic Acid, made by triturating the base with a little Water or Alcohol and combining with Oleic Acid at a moderately warm temperature.

In the Oleates of Alkaloids, except one, 50 per cent **Olive Oil** is added as a diluent.

The following are official:

Oleatum Atropinæ, U. S.—Atropine, 2 per cent.
Oleatum Cocainæ, U. S.—Cocaine, 5 per cent.
Oleatum Hydrargyri, U. S.—Yellow Mercuric Oxide, 25 per cent.
Oleatum Quininæ, U. S.—Quinine, 25 per cent.
Oleatumæ Veratrinæ, U. S.—Veratrine, 2 per cent.

Oleic Acid.—$HC_{18}H_{33}O_2$.—Acidum Oleicum, U. S.—A monobasic acid of the series of Acids contained in Fats and Oils.

By subjecting fats to cold and pressure it may be separated from the more solid stearic acid and through this is obtained as a by-product in the manufacture of stearin candles. It may also be produced from Soaps by decomposition.

A yellowish liquid, sp. gr. 0.900; insoluble in water and freely soluble in alcohol and ether. It becomes semi-solid a few degrees above the freezing point and at a lower temperature congeals to a solid mass.

Uses.—In preparing the **Oleates.**

Stearic Acid.—$HC_{18}H_{35}O_2$.—Acidum Stearicum, U. S.—One of the series of Fat Acids, constituting the principal portion of the solid animal Fats; also present in some vegetable fats. It is chiefly prepared from Tallow by separating the Stearin from Olein by expression and forming the latter into Soap with an Alkali, when the Stearic Acid is obtained by decomposing the stearate.

A hard, white, glossy solid; insoluble in water; soluble in 45 parts of alcohol, readily in boiling alcohol and in ether. The pure acid melts at 69°C.; the commercial acid should have a melting point not lower than 56°C.

Uses.—In the preparation of Soaps; also in **Suppositoria Glycerini**, U. S.

Glycerin.—$C_3H_5(OH)_3$.—Glycerinum, U. S.—A liquid obtained by the decomposition of Animal or Vegetable Fats or Oils and containing not less than 95 per cent of absolute glycerin. Chemically it is a triatomic alcohol; propenyl, or glyceryl hydrate.

It is obtained as a by-product in the manufacture of Soap, or by subjecting Fats to a high temperature under pressure and in the presence of water, when they are decomposed into fatty acids and Glycerin, the latter being distilled with Steam.

A transparent, colorless, oily liquid, sweet and warm to the taste; sp. gr. 1.246, which corresponds to 95% of absolute glycerin. Its boiling point is 165°C., but it does not vaporize unchanged, a portion of it being converted into acrolein and other empyreumatic products, but may be distilled unchanged in a current of superheated steam. It is soluble in all proportions in water and alcohol, in a mixture of 3 of alcohol and 1 of ether; miscible slightly with fixed and volatile oils; insoluble in ether, benzin, chloroform, etc.

Glycerin, like the other alcohols described, is combustible, and burns with a bluish, non-luminous flame. Like them also, there may be formed from it a series of Ethers and Aldehydes.

Uses.—The pharmaceutical uses of glycerin are important; it is the vehicle for the official **Glycerites**, enters into the menstrua of several Fluid extracts and Tinctures, is a constituent of the official tragacanth **mucilage**, and serves as a **vehicle** in many other preparations.

ESSENTIAL OILS.

The Essential or **volatile** Oils bear some resemblance in their appearance and physical properties to the **fixed** oils or fats, but they **differ** from them (1) in chemical composition, (2) in their specific gravities, (3) in their boiling points, (4) in being completely volatizable without decomposition or change and therefore not leaving a stain when volatilized from paper and (5) in not forming Soaps with Alkalies.

They are slightly **soluble** in water, in certain proportions of

alcohol, but freely soluble in ether, petroleum-benzin, chloroform, and the fixed oils; they are all **inflammable,** and burn with a smoky flame. In **specific gravity** they range from 0.82 to 1.18, but by far the larger portion of them are lighter than water. Their **boiling point** is higher than that of water—ranging from 150°C. to 250°C. They are supposed to be perfectly transparent and colorless when pure, but all undergo change on standing, being partly converted into resin, and acquire various, often characteristic, **colors.**

As to their **origin,** few occur in animal structures, but they are widely distributed in the **vegetable** kingdom, and their varieties are very numerous. Sometimes they are diffused through the entire structure of the plant, sometimes they are confined to a part, as to the **flower,** or the **fruit;** sometimes they occupy separate cells, or conceptacles, as in the **rind** of the Orange, and the oil tubes in the fruits of the Umbelliferæ. They are usually found associated with resins, and hold them in solution. For the plants that produce them they serve various **purposes.** The turpentine of Pines, and Oil of Mustard and Horseradish are doubtless **protective,** while those volatile oils that give rise to the **pleasant odors** of certain flowers serve the purpose of attracting winged insects that aid in cross-fertilization.

PRESERVATION.

Volatile oils undergo changes by standing, due partly to the effects of light and partly to the oxidizing influence of the air. This may be largely prevented by keeping the oils in the original cork-stoppered bottles in a cool and dark place. The addition of 10 per cent of alcohol also aids in their preservation.

ADULTERATIONS.

Volatile oils are liable to be adulterated with (1) fixed oils, (2) alcohol, and (3) with other (cheaper) volatile oils.

Fixed Oils may be detected by placing a drop of the suspected oil upon a piece of clean white paper, when by gently heating it, fixed oil if present will leave a permanent stain. If present in considerable quantity, fixed oils will be separated on the addition of alcohol.

Alcohol may be detected by the amount of contraction shown when measured quantities of the oil and water are mixed in a graduated glass tube; the increase in volume of the water indicates approximately the quantity of alcohol present.

Red Anilin.—If a volatile oil is colored **red** by a little red anilin, it indicates the presence of alcohol because red anilin is soluble in alcohol but insoluble in volatile oils.

Admixture of other cheaper volatile oils is more difficult of detection. If a drop of mixed oils be evaporated, from the hand or from a sheet of paper which is warmed, the **difference in odors** may be detected from time to time, as one essential oil volatizes more rapidly than another.

If the oxygenated oils are **adulterated** with Turpentine oil, as is likely on

account of cheapness, its presence may often be detected by mixing the suspected oil with 85 per cent alcohol, in which the turpentine oil is less soluble than the oxygenated, and will therefore separate.

In **judging** of essential oils by the sense of smell, particularly if in alcoholic solutions, as **perfumes**, the odor should be observed from the volatilization of a small quantity from the hand or paper rather than directly from the bottle, since the pungent odor of the alcohol, if present, obscures the odor of the essence, and evaporation of the oil cannot take place so rapidly from the liquid surface in the bottle as from the warm hand.

The volatile oils, or "Ethereal oils" as they are more correctly termed, enter largely into medicinal preparations, sometimes for **flavor**, as in the official **spirits** or "essences" sometimes as aromatic stimulants, as in the **Medicated Waters** or in the **Elæosacchara** of the Nat. Form.; but more frequently as **correctives** of nauseous drugs, as in the **Elixirs** and **Pills**.

METHODS OF PREPARATION.

The volatile oils are extracted in various ways:

(1) By **Expression**, as in the oils of Orange, Lemon and Bergamot, where the oil is secreted in conceptacles in the rinds of the fruit.

(2) By **Distillation** from Oleoresins, which are resins in solution in volatile oils, such as Turpentine and Copaiba.

(3) By **Distillation** of the aromatic substance with water.

The Substance coarsely comminuted, or in the fresh state as for example Peppermint, is first macerated with water in a still, which upon applying heat boils and vaporizing carries the oil with it. The oil being less soluble in the distillate separates and usually of a lower specific gravity than water, floats on top of the water from which it is separated. The distillate is a saturated solution of the oil in water and may be used instead of water in subsequent similar operations or as an aromatic water; Rose Water and Orange Flower Water are obtained in this way as by-products in the distillation of their respective oils. Most volatile oils distill readily in this way, but in case the boiling point of the oil be very high, common salt is sometimes added to the water, to raise its boiling point, or live steam is utilized.

(4) By extraction with **volatile** solvents, such as Alcohol, Ether, Chloroform, Petroleum-Benzin, Carbon Disulphide, etc.

The solvent is permitted to evaporate, leaving the volatile oil mixed with some impurities, from which it is freed by distillation.

(5) By extraction with **fixed** solvents, such as Fixed Oils and Fats.

Distillation, though speedy and convenient, is too wasteful for obtaining the delicate volatile **essences** of flowers, frequently present only in minute proportions. The process of enfleurage is therefore usually employed.

Enfleurage consists in sprinkling the material, from which the essence is to be extracted, on purified and odorless fat such as fresh suet contained in shallow trays. The fat after a time takes up the essence, and the exhausted material may be replaced by fresh and the process continued until a strongly perfumed **pomade** is obtained. When pomade is treated with Alcohol the essence is dissolved, while the little fat which passes into solution may be separated by exposing the alcoholic solution to a low temperature. The product thus obtained is the "**extract**" of the perfumers from which the volatile oil may also be obtained.

(6) By the **Pneumatic** process whereby the odorous principles are secured by forcing air saturated with fragrance through alcohol, which absorbs and retains in solution the perfume.

The volatile oils are classified according to their **elementary** composition as follows:

1. The **Terpenes** or Camphenes, also called "Hydrocarbons" because they have the Composition $C_{10}H_{16}$.
2. The **Oxygenated** Oils or "Essences," which contain Oxygen in addition to Carbon and Hydrogen.
3. The **Nitrogenated,** containing Nitrogen in addition to Carbon, Hydrogen and Oxygen, and
4. The **Sulphurated,** consisting of Carbon, Hydrogen, Nitrogen and Sulphur.
5. The **Empyreumatic** Oils, though treated under products of destructive distillation, may be included.

THE TERPENES.

The Terpenes, so-called because Oil of Turpentine is the type, comprise the volatile oils derived from plants belonging mostly to the natural order Coniferæ.

They are characterizezd by ranging in specific gravity from 0.840 to 0.890; in boiling point from 150°C. to 250°C.; in being **least soluble** in water and being converted into para-Cymol, $C_{10}H_{14}$, through withdrawal of two H by reaction with iodine, which becomes so intense as to cause **fulmination.** These oils react so strongly with Nitric and Sulphuric Acids that when mixed with these acids they should be cautiously added.

Oil Turpentine.—Oleum Terebinthinæ U. S.—Obtained by distillation of Turpentine Oleoresin derived from Pinus palustris.

The residue is the common **rosin** or "colophony."

A colorless liquid of a characteristic odor and taste, sp. gr. 0.855 to 0.870, boils at 155 to 170°C., soluble in 3 volumes of alcohol and in an equal volume of glacial acetic acid.

Uses.—As a solvent for resins, etc., externally in **Liniments**; internally the purified form dissolved in a fixed oil or in the form of **emulsion.**

Off. Prep.—Linimentum Terebinthinæ and the following:

Oleum Terebinthinæ Rectificatum, U. S.—Prepared by shaking common Oil of Turpentine with six volumes of Lime Water, distilling the mixture and collecting about three-fourths of the oil employed and separating it from water.

This purified oil added to boiling water is used as an **inhalant** in "consumption," bronchitis, etc.

Dose—1 cc. (15 minims).

Emulsum Olei Terebinthinæ, U. S.—Is prepared by shaking Oil Turpentine 15 cc., acacia pulverized 15 Gm., Oil Almond 5 cc., in a dry bottle; then emulsifying with 30 cc. Water, adding Syrup 25 cc. and finally Water to 100 cc.

Oil of Turpentine is a mixture of several substances, viz.: pinene, terpinene and dipentene, differing in their optical behavior, i. e., turning polarized light to the left, **levogyrate**, or to the right, **dextrogyrate**. Treated with Sulphuric Acid, at a temperature not above 70°C., washed with alkali water and that portion boiling under 160°C. separated by fractional distillation, the following is obtained:

Terebene.—Terebenum, U. S.—A liquid consisting chiefly of Dipentene and other Hydrocarbons, optically inactive, sp. gr. 0.850.

It is sparingly soluble in water, but soluble in three times its volume of alcohol, glacial acetic acid or carbon disulphide.

Uses.—As an antiseptic and deodorant.

Dose.—0.5 cc. (8 minims).

Terpin Hydrate.—$C_{10}H_{20}O_2+H_2O$.—Terpini Hydras, U. S.—The hydrate of the diatomic alcohol Terpin [$C_{10}H_{18}(OH)_2+H_2O$].

Produced through the action of Nitric Acid on Oil of Turpentine in the presence of Alcohol and crystallizing from hot alcohol or glacial acetic acid.

Colorless lustrous, rhombic, prisms, nearly odorless and having a slightly aromatic taste, soluble in 200 parts of water, in 10 of alcohol, in 100 of ether, in 200 of chloroform, and in 1 part of boiling glacial acetic acid.

Uses.—In Bronchial difficulties.

Dose.—0.125 Gm. (2 grains).

The following Oils are also included with the Terpenes:

Oleum:	Part of	Plant	Sp. Gr.	Minimum per cent active principle
Cubebæ	fruit	Piper Cubeba	0,92	
Erigerontis	herb	E. Canadense	0 86	
Eucalypti	leaf	E. globuli	0.92	Cineol 50 (vol.)
Juniperi	fruit	J. communis	0.88	
Lavandulæ	flower	L. officinaiis	0 89	
Myristicæ	seed	M. frafrans	0.90	
Rosmarini	leaf	R. officinalis	0.90	Borneol 15
Sabinæ	tops	J. Sabina	0.92	

Eucalyptol.—$C_{10}H_{18}O$.—An organic oxide, Cineol, obtained from the Volatile Oil of Eucalyptus.

Sp. gr. 0.930, boils at 176°C., congeals at a few degrees below the freezing point and is optically inactive.

Dose.—0.2 cc. (3 minims).

Oil of Copaiba.—Oleum Copaibæ, U. S.—Obtained by distillation from the Oleoresin of Copaiba.

Sp. gr. 0.900. Soluble in 2 volumes of alcohol.

Dose.—0.5 cc. (8 minims).

The Oils of the **Citrus Family**, classed with the Terpenes, are obtained by expression from the rinds of the fruits, except the Oil of Orange Flowers, which is obtained by distillation with water.

Oil of Lemon.—Oleum Limonis, U. S.—Citrus Limonum. It should contain 4 per cent by weight of Citral.

Sp. gr. 0.900 to 0.920; soluble in equal volume of alcohol.

Oil of Bergamot.—Oleum Bergamottæ, U. S. 190—.—Citrus Bergamia, Risso et P.

Sp. gr. 0.880 to 0.885, 2 volumes of oil and 1 volume alcohol, clear solution.

Uses.—In cologne water, perfumery.

Oil of Orange Peel.—Oleum Aurantii Corticis, U. S.—Citrus Aurantium.

Sp. gr. 0.850; soluble in 4 volumes of alcohol.

Off. Prep.—Spiritus, Aurantii Compositus.

Oil of Orange Flowers.—Oleum Aurantii Florum, U. S. '90.—Oil Neroli.—Citrus vulgaris, Risso.

Sp. gr. 0.875 to 0.890; soluble in equal volume of alcohol.

THE OXYGENATED OILS.

The Oxygenated Oils, or "**Essences**" as they are sometimes called, comprise a large number of volatile oils, containing, in addition to H and C, also a small proportion of Oxygen.

Most of these oils are mixtures of two or more principles; a **Solid**, formerly called "Stearoptene" and a **liquid** "eleoptene."

This crude grouping is no longer acceptable, however, the principal constituents being **aldehydes, oxides, esters** and **phenols,** some of which **congeal** at low temperatures and may thus be separated from the more liquid portion, others require decomposition by reagents and fractional distillation for their separation.

Physically they differ from the Terpenes proper, the Turpentines, in having a finer, more agreeable **odor**, hence their value as perfumes; they are slightly more although sparingly **soluble** in water, and the official **Aromatic Waters** are saturated solutions of these oils; they have a **higher** specific gravity, ranging with two exceptions from 0.900 to 1.175; and have a somewhat higher boiling point.

Uses.—A great many oils belonging to this class, not official, are used in **perfumery**, such as the Ihlang, Jasmin, etc.; many are employed as **flavors**, and the savory herbs of Marjoram, Mints and Thyme, the fruits of Anise, Caraway, Pepper and Coriander, the flowers of Cloves and Mace and the barks of Cinnamon are all used in the **culinary arts**.

The oxygenated oils are employed for their aromatic and stimulant effect, in Waters and Spirits, often as **carminatives** and most frequently as **adjuvants** to nauseous preparations and as **correctives** to drastic cathartics, as in pills.

Some have specific effects, as the **abortifacients**, Pennyroyal Rue, Tansy (and Sabin) and therefore are dispensed only on prescriptions.

Oleum:	Part of	Plant	Sp. Gr.	Minimum per cent active principle
Anisi	fruit	Pimpinella A.	0.98	
Betulæ	bark	B. lenta	1.175	
Cajuputi	leaves	Melaleuca Leucadendron	0.922	Cineol 55 (vol.)
Cari	fruit	Carum Carui	0.910	
Caryophylli	flor's	Eugenia arom	1.060	Eugenol 80 (vol.)
Chenopodii	fruit	C. anthel-minticum	0.980	
Cinnamomi	bark	C. cassia	1.055	Cinaldehyde 75 (vol.)
Coriandri	fruit	C. sativum	0.870	
Fœniculi	rruit	F. vulgare	0.960	
Gaultheriæ	leaves	G. procumbens	1.175	
Hedcomæ	"	H. pulegioides	0.930	
Menthæ pip	"	M. piperita	0.900	Menthol 50 (wt.)
Menthæ Vir	"	M. viridis	0.930	
Pimentæ	f.uit	P. Officinal is	1.045	Eugenol 65 (vol.)
Rosæ	flor's	R. Demascena	0.865	
Santali	wood	S. album	0.970	Santalol 90 (wt.)
Sassafras	rt-bark	S. variifolium	1.070	
Thymi	leaves	T. vulgaris	0.900	Phenols 20 (vol.)

THE NITROGENATED OILS.

The nitrogenated or complex oils are but few in number, and the plants which yield them all belong to the Rosaceæ, and most of them to the sub-order Amygdalæ. They contain Hydrocyanic Acid in solution in the oil, and are therefore poisonous.

Their specific gravity varies from 1.04 to 1.07, boiling points from 170°C. to 180°C, and they are acid to litmus paper.

The most important of this group are: Oil of Cherry-seeds, Oil of Cherry-laurel leaves, and:

Oil of Bitter Almonds.—Oleum Amygdalæ Amaræ, U. S.—Obtained from Bitter Almonds and other Seeds containing **Amygdalin,** by macerating with water, and afterward distilling.

It should contain not less than 85 per cent **Benzaldehyde** and not less than 2 per cent, nor more than 4 per cent **Hydrocyanic Acid.**

Its sp. gr. is 1.060, soluble in 300 parts water, in all proportions of alcohol.
Dose.—0.03 cc. (½ minim). **Poisonous.**

Off. Prep.—Aqua Amygdalæ Amaræ; Spiritus Amygdalæ Amaræ.

THE SULPHURATED OILS.

Pungent essences characterized chemically by containing a small proportion of Sulphur. Most of these oils are obtained from plants belonging to the Cruciferæ, but Oil of Asafœtida is derived from an Umbelliferous, and Oil of Garlic from a Liliaceous plant.

Volatile Oil of Mustard.—Oleum Sinapis Volatile, U. S.—Is obtained from Black Mustard by maceration with water, and subsequent distillation. It occurs, also, in other Cruciferous plants.

It should contain 92 per cent. **Allyl iso-thicoynate**—(C_3H_5CNS.)

A colorless, pungent and acrid liquid; sp. gr. 1.02; boils at 150°C.

Dose.—0.008 cc. (1/8 minim).

Oils of **Horse-radish, Asafœtida** and **Garlic** are of similar composition.

SOLID DERIVATIVES.

Closely allied to the volatile oils are the **camphors,** and some of the volatile oils may by long exposure to water and the atmosphere be converted into camphors.

Camphor.—$C_{10}H_{16}O$.—Camphora, U. S.—The dextrogyrate modification of the saturated Ketone ($C_9H_{16}CO$) from Cinnamomum Camphora, L., obtained by distilling the branches with water and purified by sublimation.

Triturated in molecular proportions with menthol, thymol, phenol, or chloral hydrate, **liquefaction** ensues.

Owing to the toughness of its crystals, it cannot be **pulverized** in a mortar unless first moistened with alcohol, ether, or volatile oil. It may, however, be obtained in a finely divided state by condensing the hot vapors.

Camphor melts at 175°C.; boils at 204°C.; is inflammable, burning with a sooty flame. Sp. gr. 0.99; very sparingly soluble in water, readily in alcohol, ether, chloroform, fixed and volatile oils.

Off. Prep.—Aqua Camphoræ; Ceratum Camphoræ; Ceratum Plumbi Subacetatis; Linimentum Belladonnæ; Linimentum Saponis; Spiritus Camphoræ, Tinctura Opii Camphoratæ.

Av. Dose.—0.125 Gm. (2 grains).

Monobromated Camphor.—$C_{10}H_{15}BrO$.—Camphora Monobromata, U. S.—A substitution product of Camphor and Bromine.

White crystals or scales, almost insoluble in water, soluble in alcohol, ether.

Uses.—Similar to Bromides in pill form.

Av. Dose.—0.125 Gm. (2 grains).

Camphoric Acid.—$H_2C_{10}H_{14}O_4$.—Acidum Camphoricum, U. S.

With the Camphors may be classed the following substances:

Thymol.—$C_{10}H_{14}O$.—Thymol, U. S.—A phenol, obtained from the volatile oils of Thymus vulgaris, and Monarda punctata, L., and Carum Ajowan.

By fractional distillation the terpenes are separated and the portion coming over at 175°C. is treated with soda, decomposed by hydrochloric acid and the thymol crystallized from an alcoholic solution.

Large, colorless crystals, sp. gr. 1.03, melts at 50°, sparingly soluble in water (100), readily in alcohol, ether, etc., fixed and volatile oils.

Uses.—As an **antiseptic** and **disinfectant.**

Dose.—0.125 Gm. (2 grains).

Thymol Iodide.—$C_{20}H_{24}O_2I_2$.—Thymolis Iodidum, U. S.—Dithymol-diiodide $[(C_6H_2.CH_3.C_3H_7.OI)_2]$—by condensation of 2 molecules Thymol and introduction of 2 atoms of Iodine into the Phenol groups. It contains 45 per cent Iodine.

A reddish-yellow, light powder; insoluble in water and glycerin, slightly in alcohol, readily in other solvents.

Uses.—A Deodorant and **Antiseptic; externally as a Dusting Powder.**

Menthol.—$C_{10}H_{19}OH$.—Menthol, U. S.—Secondary Alcohol obtained by fractional distillation from American and Japanese peppermint oils.

Colorless, acicular or prismatic crystals, melting at 43° C., boil at 212°C., sparingly soluble in water, freely in alcohol, ether, etc.

Uses.—As a topical application in nervous headache. Antiseptic.

Dose.—0.065 Gm. (1 grain).

LIQUID PRINCIPLES.

In addition to these, several other of the principles to which the volatile oils owe their value are official.

These are obtained either from the natural oils by chemical methods and fractional distillation or produced **synthetically.**

They are liquid, ranging in specific gravity from 1.045 to 1.105, practically insoluble in water, readily in alcohol and other solvents. They are all **optically inactive.**

Benzaldehyde.—C_7H_6O.—Benzaldehydum, U. S.—An aldehyd obtained from the volatile oil of bitter almond or produced artificially, containing 85 per cent. pure benzaldehyd.

Dose—0.03 cc. (½ minim.)

Cinnamic aldehyde.—C_9H_8O.—Cinnaldehydum, U. S.—An aldehyd obtained from oil of cinnamon or prepared synthetically, containing not less than 95 per cent, pure cinnamic aldehyde.

Dose.—0.05 cc. (1 minim.)

Eugenol—$C_{10}H_{12}O$.—Eugenol, U. S.—An unsaturated aromatic phenol obtained from oil of cloves and other sources.

Dose.—0.2 cc. (3 minims.)

Safrol.—$C_{10}H_{10}O_2$.—Safrolum, U. S.—The methylene ether of pyrocatechol, found in oil of sassafras, camphor oil and other volatile oils.

Dose.—0.3 cc. (5 minims.)

AROMATIC DRUGS, GROUP IV.

The Aromatic Drugs include those vegetable drugs whose chief value consists in the **volatile oil** which they contain. They are mostly **stimulant** and **carminative** in their properties.

The **Average Dose** of these Drugs, unless stated to the contrary, is 1 Gm. (15 grains).

A few of them, Buchu, Cubeb, Eucalyptus, Ginger and Valerian, are sufficiently active to be administered alone as extractives, but the rest are merely used as **aromatics** and **adjuvants,** and enter largely into various **Elixirs, Syrups** and similar compounds preparations. Their preparations generally **precipitate** with water, and in the degree this precipitation takes place, the strength of the preparation, or the quality of the drug from which it is prepared, may be roughly estimated.

Nearly all require **stronger alcoholic menstrua** in their extraction, yet they should contain some **water,** which, by causing the cell-walls to swell, enables the alcohol to dissolve the active constituents and facilitate the extraction of the drug.

The active principles or volatile oils of some of the drugs belonging to this class, especially those of the Orange and Rose families, are soluble to some extent in **Syrup,** which is the most common form of exhibition; less soluble in water not containing sugar, however, such solutions can not be so concentrated that the syrups can be prepared from them by admixture with simple syrup. Their principal use is in the manufacture of **essential oils.**

Drugs may contain a volatile oil and yet contain **other constituents** such as resins, tannin or glucosides and alkaloids. In such cases reference is made to the Drug in this Group, but it is described in the particular Group in which, through its most active constituents, it would be most appropriately included.

Anise.—Anisum, U. S.—Fruit of Pimpinella Anisum, Umbelliferæ. Constituents: Vol. oil about two per cent, sugar, mucilage, etc. Prep.: Tinctura Rhei Dulcis.

Arnica.—Flowers. [See Group 5.]

Buchu.—Buchu, U. S.—Leaves of Barosma betulina, Bart.,

Rutaceæ. Constituents: Vol. oil about one per cent, resin, bitter principle, etc. Off. Prep.: Fluid extractum Buchu. Dose—2 Gm.

Short buchu is the only kind recognized in the U. S. Ph. It contains a larger percentage of oil than the variety known as "long" buchu (Barosma serratifolia) and is much lower in price.

Calamus.—Calamus, U. S.—Rhizome of Acorus Calamus L., Araceæ. Constituents: Vol. oil one-half per cent, bitter principle, resin, etc. Off. Prep.: Fluidextractum Calami.

Uses.—A **tincture** containing 20 per cent of the drug made with the alcohol, and an **extract** with 60 per cent alcohol, and **infusion** 5 per cent strength. A conserve is also made from the peeled root with sugar.

Caraway.—Carum, U. S.—Fruit of Carum Carvi, L., Umbelliferæ. Constituents: Vol. oil six per cent.

Uses.—As an aromatic in **Elixirs** and "**Tonics**," also as **condiment**, and as an ingredient in cheese.

Cardamom.—Cardamomum, U. S.—Fruit of Elettaria repens, Baillon. Zingiberaceæ. Constituents: Vol. oil four-fifths per cent, fixed oil, mucilage, etc. Off. Prep.: Pulvis Aromaticus; Tinctura Cardamomi; Tinctura Cardamomi composita; Tinctura Gentianæ comp.; Tinctura Rhei; Extract. Colocynthidis Comp.

Malabar and **Aleppo** constitute the shorter varieties of Cardamom, which are round in shape, while the **Madras** are more elongated. Good Cardamom should yield 75 per cent of their weight in seeds.

Saigon Cinnamon.—Cinnamomum Saigonicum, U. S.—The bark of an undetermined species of Cinnamomum Lauraceæ.

Ceylon Cinnamon.—Cinnamomum Zeylanicum, U. S.—The inner bark of the shoots of Cinnamomum Zeylanicum, Breyne.

Constituents.—About 1 per cent of volatile oil, and a little tanin.

Uses.—Cinnamon is valuable in medicine chiefly for its carminative and stimulant virtues and for the preparation of the volatile oil.

Off. Prep.—Pulvis Aromaticus; Infusum Digitalis; Tinctura Cinnamomi; Tinct. Cardamomi comp.; Tinct. Gambir comp.; Tinct. Lavandulæ comp.; Tinct. Rhei Aromat.; Vinum Opii; also in numerous unofficial preparations and in **Elixirs**.

Uses.—In the powdered form as a **spice** and sometimes for dusting pills. Cassia Cinnamon is the kind mostly used for **culinary** purposes; Saigon for **flavoring** cordials, elixirs, etc.; Ceylon Cinnamon in **perfumery**, also for flavoring.

Cloves.—Caryophyllus, U. S.—Flower Buds of Eugenia aromatica, Kuntze. Myrtaceæ. Constituents: :Volatile oil eighteen per cent, caryophyllin, eugenin, resin tannin, etc. Off. Prep.:

Tinctura Lavandulæ comp.; Tinct. Rhei Arom.; Vinum Opii, and externally as an ingredient in the unofficial **Spice Plaster.**

Coriander.—Coriandrum, U. S.—Fruit of Coriandrum sativum, Umbelliferæ. Constituents: Volatile oil one-half per cent and fixed oil.

Uses.—To **correct** griping in laxative remedies as in the official confection of Senna; as a very agreeable **flavor** in Elixirs, and as a promoter of digestion in the compound of various spices, known as "Curry Powder."

Cubeb.—Cubeba, U. S.—Unripe fruit of Piper Cubeba, Piperaceæ. Constituents: Volatile oil ten per cent, resin, cubebin, cubebic acid. Off. Prep.: Fluid extractum Cubebæ; Oleoresina Cubebæ, Trochisca Cubebæ.

Cubebic acid and cubebin, also described an indifferent resin, represents all the medicinal value of cubeb, the oil being regarded as nearly **inert.**

Uses.—Crushed and made into **cigarettes** for smoking, powdered and mixed with potassium sulphate as **Catarrh Snuff,** and made into a **paste** with mucilage and Copaiba for gonorrhœa.

Eriodictyon.—Eriodictyon, U. S.—Yerba Santa.—The leaves of Eriodictyon Californicum, Green, Hydrophyllaceæ. Constituents: Volatile oil, an acid and possibly a glucoside. Off. Prep.: Fluid extractum Eriodictyi.

Eucalyptus.—Eucalyptus, U. S.—Leaves of Eucalyptus globulus, Labillardiere. Myrtaceæ. Constituents: Volatile oil six per cent, resin, tannin. Off. Prep.: Fluidextractum Eucalypti.

Uses.—As an addition to quinine mixtures, externally as a **wash;** in conjunction with cubeb for **smoking** in Catarrh.

Fennel.—Fœniculum, U. S.—Fruit of Fœniculum vulgare, Miller, Umbelliferæ. Constituents: Volatile oil about four per cent, fixed oil sugar. Off. Prep.: Infusum Sennæ comp.

Uses.—In **Species Laxantes** Ph. Ger., "St. Germain" or "Hamburger The" and similar preparations to correct the **harsh** action of purgatives.

Ginger.—Zingiber, U. S.—Rhizome of Zingiber officinale, Roscoe. Zingiberaceæ. Constituents: Volatile oil one-half per cent, gingerol, resin, starch, etc. Off. Prep.: Fluid extractum Zingiberis; Oleoresina Zingiberis; Pulvis Aromaticus; Pulvis Rhei comp.; Tinctura Zingiberis.

Ginger occurs in the market usually with the outer integuments removed, when it is called "**uncoated ginger;**" it is also frequently **bleached** by immersion in a solution of chlorinated lime to give it a white appearance. Of the two varieties, the African and the Jamaica, only the latter (unbleached) should be used in pharmacy.

Uses.—Similar to the other **spices,** and as an ingredient in "**Curry Powder.**"

Hedeoma.—Hedeoma, U. S.—Pennyroyal.—Leaves and flowering tops of Hedeoma pulegioides, Persoon., Labiatæ. Constituents: Volatile oil. **Average Dose**—8 Gm.

Uses.—As **infusion** to bring on retarded or suspended menstruation.

Lemon Peel.—Limonis Cortex, U. S.—The undried rind of fruit of Citrus Limonum, Risso. Rutaceæ. Constituents: Volatile oil two per cent, hesperidin. Off. Prep.: Tinctura Limonis Corticis.

Uses.—For flavoring.

Marrubium.—Marrubium, U. S.—Horehound.—Leaves and tops of Marrubium vulgare, Labiatæ. Constituents: Volatile oil, resin, marrubin, tannin.

Uses.—Properly as an ingredient in "**Cough Syrups**" and Infusion.

Matico.—[See Group 5.]

Nutmeg.—Myristica, U. S.—The kernel of the seed of Myristica fragrans, Houttuyn. Myristicaceæ. Constituents: Volatile oil about five per cent and fixed oil twenty-five to thirty per cent. Off. Prep.: Pulvis Aromaticus; Acetum Opii; Tinctura Lavandulæ composita; Tinct. Rhei Arom.; and as a flavor.

Dose.—0.5 Gm. (8 grains).

Bitter Orange Peel.—Aurantii Amari Cortex, U. S.—Rind of unripe fruit of Citrus vulgaris, Risso., Rutaceæ. Constituents: Volatile oil and hesperidin. Off. Prep.: Fluid extractum Aurantii Amari; Tinctura Aurantii Amari; Tinct. Cinchonæ comp.; Tinct. Gentianæ comp.

Uses.—Owing to its large percentage of bitter principle, Bitter Orange Peel is used in the several tinctures, and also in many unofficial tonics and bitters. The volatile oil, while present in much smaller quantity than in the Sweet Orange Peel, is largely used, and sometimes preferred to that of the latter.

The volatile oil obtained of bitter orange (orange berries) called **essence de petit grain,** is similar in chemical composition to the oil of orange, but differs in taste and odor.

Sweet Orange Peel.—Aurantii Dulcis Cortex, U. S.—Rind of fresh fruit of Citrus Aurantium, L., Rutaceæ. Constituents: Volatile oil and hesperidin. Off. Prep.: Syrupus Aurantii, Tinctura Aurantii Dulcis.

Uses. A superior tincture is made by macerating the yellow **exterior** portion, deprived of the inner white fleshy portion, with alchol. It is the chief **flavor** for **Elixirs.**

Pepper.—Piper, U. S.—Black Pepper.—Unripe fruit of Piper nigrum, L., Piperaceæ. Constituents: Volatile oil one-half per cent, piperin, pungent resin. Off. Prep.: Oleoresina Piperis.

Uses. Sometimes as an addition to **Anti-Chill Pills** to render other remedies, such as quinine, more active. It is the best known and most

largely used of all condiments. The powder is often largely adulterated.

Dose.—0.5 Gm (8 grains).

Peppermint.—Mentha Piperita, U. S.—Herb of Mentha piperita, Labiatæ. Constituents: Volatile oil one per cent, pipmenthol, resin, tannin. Off. Prep.: Spiritus Menthæ Piperitæ.

Uses.—For obtaining oil of Peppermint; also for imparting a green color to the alcholic solution of the oil in "**Essence of Peppermint.**"

Dose.—4 Gm.

Pimenta.—Pimenta, U. S.—Allspice.—Nearly ripe fruit of Pimenta officinalis, Lindley, Myrtaceæ. Constituents: Volatile oil three-fourths per cent, resin tannin, etc.

Uses.—As a **condiment** and for obtaining the oil, used in **Bay Rum.**

Red Rose.—Rosa Gallica, U. S.—Petals of Rosa Gallica, L., Rosaceæ. Collected before flowers are fully expanded. Constituents: Volatile oil, sugar, mucilage, quercitrin. Off. Prep.: Pilulæ Aloes et Mastiches; Confectio Rosæ.; Fluid extractum Rosæ; Mel Rosæ.

Uses.—The **Infusion,** formerly official, containing sugar and dilute sulphuric acid as a vehicle for bitter drugs, i. e., magnesium sulphate and quinine; also as a **gargle** for sore throat and in **Fumigating Powder** and **Pastilles.**

Salvia.—Salvia, U. S.—Sage.—Leaves of Salvia officinalis, Labiatæ. Constituents: Volatile oil one-half to three-quarters per cent, resin, tannin extractive matter.

Uses.—Infusion in sore mouth and as a **gargle** in sore throat.

Sassafras.—Sassafras, U. S.—Root bark of Sassafras variifolium, Kuntze. Laurineæ. Constituents: Volatile oil four per cent, tannin six per cent, sassafrid nine per cent. Off. Prep.: Fluid extractum Sarsaparillæ comp.

Uses.—Chiefly in the preparation of the oil of sassafras by distillation; in infusion as "tea" for purifying the blood, and in **Species Lignorum** Ph. Ger.

Scutellaria.—Scutellaria, U. S.—Skullcap.—Plant of Scutellaria lateriflora, L., Labiatæ. Constituents: Volatile oil, bitter principle, tannin. Off. Prep.: Fluid extractum Scutellariæ.

Spearmint.—Mentha viridis, U. S.—Leaves and tops of Mentha spicata, L., Labiatæ. Constituents: Volatile oil about one-half per cent, resin, etc. Off. Prep.: Spiritus Menthæ Viridis.

Sumbul.—Sumbul, U. S.—Root of Ferula Sumbul, or undetermined, Umbelliferæ. Constituents: Volatile oil one-third per cent, angelic and valerianic acids and bitter extractive. Off. Prep.: Fluid extract Sumbul, Extractum Sumbul.

Thuja.—[See Group 5.]

Valerian.—Valeriana, U. S.—Rhizome and rootlets of Valeri-

ana officinalis, L., Valerianaceæ. Constituents: Volatile oil two per cent, valeric, formic and acetic acids and resin. Off. Prep.: Fluid extractum Valerianæ; Tinctura Valerianæ; Tinctura Valerianæ Ammoniata.

Two kinds of Valerian are found in the market, viz: **English** and **German**, the former being regarded as representing the medicinally valuable constituents in a higher degree than the German. It should always be given the preference, but never used until freed from adhering dirt by washing with water.

Uses.—Infusion and the powder in the form of pills. Dose 2 Gm.

Extract of Valerian was described in the U. S. Ph., '80, the Abstract taking its place; the abstract represents the drug quite as fully as the extract, and may be dispensed in the same dose.

Vanilla.—Vanilla, U. S.—Fruit of Vanilla planifolia, Andrews. Orchideæ. Constituents: Vanillin, fixed oil, resin. Off. Prep.: Tinctura Vanillæ.

Uses.—As a **flavoring** agent in the form of Tincture, or triturated to a fine powder with sugar of milk or rock-candy—frequently with an admixture of **Tonka.**

UNOFFICIAL AROMATIC DRUGS.

COM. NAME.	BOT. NAME.	PART USED.	CONSTITUENTS in addition to vol. oil.
Achillæa (Yarrow)	Achillæa millefolium.	Herb.	Achilleine, resin, tannin.
Angelica.	Archangelica officials.	Root.	Acids, resins.
Angelica (Amer.).	Archangelica atropurpurea.	Root.	(Same as above).
Apium.	Apium graveolens.	Fruit.	Fixed oil, etc.
Artemisia.	Artemisia vulgaris.	Herb.	Bitter principle.
Asarum (Canada Snake Root).	Asarum Canadense.	R'zome.	Resin, coloring matter.
Benzoin Bush.	Benzoin odoriferum.	Bk. Fruit	Tannin.
Canella.	Canella alba.	Bark.	Resin, bit. prin.
Cascarilla.	Croton Eluteria.	Bark.	Cascarillin, resin.
Cataria.	Nepeta Cataria.	Herb.	Bitter prin'l.
Chenopodium.	C. anthelmint.	Fruit.	
Comptonia.	Comptonia asplendifolia.	Leaves.	Resin, tannin, alkaloid.
Cotula (Maywood).	Maruta Cotula.	Herb.	Anthemic and valeric acids, acrid fixed oil.
Erigeron (Fleabane).	Erigeron Canadensis.	Herb.	Bitter prin'l.
Gaultheria.	Gaultheria procumbens.	Leaves.	(Methyl salicylate), Ericolin, tannin, etc.
Glechoma.	Glechoma Hederaceæ.	Herb.	Bitter prin'l.
Golden Rod.	Solidago odora.	Herb.	
Hyssop.	Hyssopus officinalis.	Herb.	Bitter prin., tannin
Illicium.	I. Verum.	Fruit.	Resin, tannin.
Imperatoria.	Imperatoria ostruthium.	Root.	Imperatorin.
Iris (orris).	Iris Florentina.	R'zome.	Resin, bitter extractive, starch.
Juniper.	Juniperus communis.	Twigs.	Resin.
Laurel.	Laurus nobilis.	Leaves.	Bitter prin'l.
Lavender.	Lavandula vera.	Flowers.	Resin, tannin.
Levisticum (Lovage).	Levisticum officinale.	Root.	Bitter extract., resins.
Mace.	Myristica frag.	Arilode.	Fixed oil, resin.
Marjoram.	Origanum marjorana.	Herb.	
Melissa.	M. officinalis.	Herb.	Resin, tannin.
Micromeria.	Micromeria Douglassii.	Herb.	
Origanum.	Origanum vulgare.	Herb.	Resin bitter princip.
Parsley.	Petroselinum sativum.	Root and Seed.	Apiin.
Pimpernel.	Pimpinella saxifraga.	Root.	Acrid resin.
Rose, Pale.	R. Centifolia.	Petals.	Sugar, tannin.
Rosmarinus.	Rosmarinus officinalis.	Leaves.	Resin, tannin.
Rhus (aromatic).	Rhus aromatica.	Root-bk.	
Saffron.	Crocus Sativ.	Stigma.	Crocin.
Sambucus.	S. Canadensis.	Flowers.	Resin, mucil'g.
Sandalwood.	Santalum album.	Wood.	Resin.
Sarsaparilla (False).	Aralia nudicaulis.	R'zome.	Resin.
Spikenard (Amer.).	Aralia racemosa.	R'z; Root	Resin.
Tansy.	Tanacetum vulg.	Herb.	Bitter picp., resin, tan.
Thyme.	Thymus vulgaris.	Herb.	Resin.
Turmeric.	Curcuma longa.	R'zome	Pungent resin.
Wintera.	Drimys Winteri.	Bark.	Tannin, pungent resin.
Xanthoxylum (Prickly Ash).	Xanthoxylum fraxineum.	Fruits.	Resin
Zedoaria.	Curcuma Zeodaria.	R'zome.	Pungent Resin.

RESINS AND OLEORESINS.

Resins are solid, usually amorphous, vegetable products, commonly with a **conchoidal** fracture, **soluble** in alcohol and usually also in the fixed oils but not in water, transparent or semi-transparent, readily **fusible,** inflammable, and burning with a sooty flame, not volatilizing without undergoing chemical change and negatively electrified by friction. Some contain **acids,** and with the alkalies are capable of forming soaps; others are **neutral,** and can not be saponified.

Composition.—The Resins are complex bodies, being mostly mixtures of different compounds of Carbon, Oxygen and Hydrogen. Shellac, for instance, consists of five different resins and a coloring matter. Amber is a mixture of Succinic Acid and several resins; Sandarac consists of three resins, which are insoluble, and a fourth constituent, a bitter principle, which is soluble, in water.

Origin.—The resins are widely distributed through the vegetable kingdom, few plants being entirely destitute of them, while some secrete them in large proportion. Some are diffused through all the tissues of the plant, others collect in certain parts, as in the heart-wood in Guaiac; sometimes they accumulate in special secretion cells, which may be isolated, collected in masses, or coalescent, forming tubes or ducts. These secretions may occasionally be poured into intercellular spaces, and represent small isolated areas, or form tubes in the leaves, wood or bark, following the direction in length of the organ in which they occur.

The **mode of formation** of the resins is obscure, but they are probably degradation products, resulting from the partial breaking down of vegetable tissues. It has been observed in some instances that, as resin accumulates in a tissue, the cell-walls of that tissue become thinner and finally disappear, and resin would therefore appear to be the product of the **retrograde metamorphosis of cellulose** or lignin. But that the change is not immediate, but first into Volatile Oil and then into Resin, is indicated by the fact that most Volatile Oils, on standing exposed to light and air, partially change into Resin, and also by the fact that Resin appears always to exist in the plant associated with **volatile oil.**

Some of the resins are used **medicinally,** but the larger portion of them are chiefly valuable for **varnishes.**

THE OLEORESINS.

The Oleoresins, like the resins, are of vegetable origin, and consist of mixtures in various proportions of **resins** with **volatile oils.** They therefore partake of the characters of both.

(1) Natural Oleoresins, to which belong Copaiba, the Turpentines and Pitches, and

(2) Pharmaceutical Oleoresins, a Class of Semi-liquid Preparations made by extracting **Oleoresinous** Drugs with Ether or Acetone.

These are the only kind having the official title "Oleoresin" in the U. S. Ph., and are made from the following drugs: Aspidium, Capsicum, Cubeb, Lupulin, Pepper and Ginger. They are described with the Pharmaceutical Preparations in a following Lecture.

Only the **natural** Oleoresins will be here considered.

Copaiba.

Copaiba.—Copaiba, U. S.—Commonly called "Balsam of Copaiba." The Oleoresin derived from various South American species of Copaiba, Leguminosæ. The oleoresin contained in ducts, frequently of large size, in the interior of the trunk, is obtained by boring holes into the heart-wood.

Light yellow or brownish yellow; transparent or somewhat turbid, viscid liquid, with a peculiar aromatic odor and an acrid, bitter, and nauseous taste. Sp. gr. from 0.95 to 0.99, increasing with age; soluble in absolute alcohol, benzene, chloroform, ether, carbon disulphide, fixed and volatile oils; insoluble in water. When heated on a water-bath no odor of Turpentine should develop and it should yield 50% residue.

There are several commercial kinds of Copaiba which differ in the relative **proportions** of volatile oil and resin.

Rio Janeiro and **Maranham** contain volatile oil and resin in nearly equal amounts. **Para** contains from 70 to 85 per cent of volatile oil; while **Maracaibo** contains from 20 to 40 per cent volatile oils, being correspondingly richer in resin. This is called "**solidifiable**" Copaiba because it makes a firm Mass with Magnesia and it is also preferred to other kinds because the resin is the most valuable therapeutically, the oil being comparatively inert.

Adulterations.—Castor and other fixed oils, turpentine and other volatile oils, and other oleoresins, as **Gurjun balsam.** **Fixed oils** are detected by the sticky residue on evaporating the volatile oil, by the greasy areola left around the resin when a drop of the suspected article has its volatile oil volatilized from paper, and by the fact that most fixed oils are insoluble in alcohol. Volatile oils are recognized usually by their odor when warmed.

The presence of "Gurjun Balsam" is detected by the coloration produced when 4 drops of Copaiba is dropped on a mixture in a test tube of 1cc Glacial acetic acid and 4 drops of nitric acid.

Constituents.—Volatile oil, copaivic, oxycopaivic, or metacopaivic acid, various resins, and a bitter principle soluble in water.

Uses.—Expectorant, diuretic and stimulant usually in the form of **Mixtures** (N. F.), **Emulsion, Paste,** or **Pill,** made from the **Mass** of Copaiba formerly official, prepared from Magnesia 4, water 1, Copaiba 96.

Dose.—I cc, (15 minims.)

Gurjun Oleo-Resin, commonly called Gurjun Balsam.—Product of Dip-

terocarpus turbinatus, and other species of the same genus of trees, indigenous to India and the Malay Archipelago.

Obtained by making deep incisions in the trunk, and then charring it, causing the oleoresin to flow freely.

It closely resembles Copaiba in odor, but the taste is more bitter and not acrid. When heated to 130°C., it gelatinizes and does not resume its fluidity on cooling. Sp. gr. from 0.95 to 0.96; entirely soluble in carbon disulphide, chloroform, and the volatile oils, but only partly so in alcohol, and petroleum benzin.

Constituents.—Gurjunic acid, resin and volatile oil.

Uses.—Similar to those of Copaiba.

THE TURPENTINES.

The several turpentines used in pharmacy are the products of trees belonging to the Pinaceæ and Coniferæ. Cyprus turpentine is the product of one of the Anacardieæ.

The Volatile Oils in all of them are identical in chemical structure, $C_{10}H_{16}$, though different somewhat in odor.

Common Turpentine.—Terebinthina, U. S.—Commonly called "gum" or "pitch" turpentine. A concrete oleoresin obtained as an exudation from Pinus palustris, Miller, and other species of Pinus.

In yellowish, opaque, tough masses, brittle in the cold, of a terebinthinate odor and taste, containing about 30 per cent of volatile oil and resin.

Uses.—Diaphoretic, diuretic, stimulant and astringent, **externally** in ointments and plasters. Its principal use is in the preparation of "turpentine" oil, which is obtained by distillation, the residue being "**rosin.**"

Canada Turpentine.—Terebinthina Canadensis, U. S.—A liquid or semi-liquid oleoresin obtained as an exudation from the Balsam Fir, Abies balsamea, Miller.

Transparent when pure, slightly yellowish or greenish, viscid, odor and taste similar to common turpentine, but more agreeable, with age hardening, and acquiring a distinct yellow color.

Composition.—Volatile oil and two resins, one readily soluble in alcohol, the other with difficulty.

Uses.—Stimulant, diaphoretic, diuretic, mostly **externally** as an application to **Frost-bites**, and as a mounting medium in **microscopy.**

Unofficial Turpentines and Pitches.

Venice Turpentine.—Terebinthina Veneta.—Product of the European larch, Larix Europæa. Secreted in the heart-wood, and is obtained by boring holes to the center of the tree and dipping the liquor out as it accumulates.

Dense, nearly colorless, transparent, fluorescent liquid of a terebinthinate odor and an aromatic, acrid, and bitter taste.

Composition.—Volatile oil, two or more resins, and succinic acid. Completely soluble in alcohol.

The Oleoresins may be divided into:

Uses.—Stimulant, diuretic and diaphoretic; **externally** in ointments.

Strasburg Turpentine.—Terebinthina Argentoratensis. Product of Abies pectinata, resembles Canada Balsam in its composition, properties and uses. Odor more agreeable. Contains a small amount of succinic acid.

Cyprian or Chian Turpentine.—Terebinthina Chia. Product of Pistacia terebinthus, Anacardieæ. Obtained from incisions in the bark of the tree.

Transparent or nearly so, semi-fluid or hardened, brownish or greenish-yellow in color; taste somewhat bitter, odor balsamic, somewhat fennel-like.

Composition.—Volatile oil and two resins, one soluble in cold alcohol, the other insoluble.

Uses.—Similar to those of other turpentines; sometimes in **Emulsion.**

Burgundy Pitch.—Pix Burgundica, U. S. '90.—Exudation product of Abies excelsa, or Norway Spruce Fir, a native of Central and Northern Europe.

Hard, but yielding without fracture to slowly graduated pressure, semi-transparent or opaque, yellowish or brownish, fracture shining, conchoidal; odor aromatic; taste agreeable. Almost entirely soluble in glacial acetic acid or in boiling alcohol and partly soluble in cold alcohol.

Composition.—Volatile oil, resin, and a little water.

Uses.—For ointments and plasters, formerly official.

Prep.—Emplastrum Picis Burgundicæ; Emplastrum Picis Cantharidatum.

Hemlock Pitch.—Pix Canadensis, U. S. '80.—Exudation product of common Hemlock, Abies Canadensis.

Dark reddish brown in color, with a weak terebinthinate, balsamic odor, and resembles in its composition, properties and uses, Burgundy pitch.

Tar.—Pix Liquida, U. S.—Products of the destructive distillation of the wood of various species of Pine; described with the products of destructive distillation of wood.

THE RESINS.

The Resins may be divided into (1) Resins obtained from Oleoresins, as residue in separation of the Oil by **distillation,** (2) natural **exudations** and (3) resins **precipitated** from Extracts of Drugs.

The latter class are treated with the Pharmaceutical Preparations.

To the first Class belong:

Rosin.—Resina, U. S.—Common Rosin or Colophony.—The residue after distilling the volatile oil from the Oleoresin of Turpentine.

The residue while hot, is drawn off and passed through a series of strainers, when on cooling it constitutes the commercial "rosin." The color of the product varies according to the temperature at which the distillation takes place.

Transparent, light or dark amber colored masses, having a vitreous fracture, fusible at about 100°C., soluble in alcohol, ether, and in both volatile and fixed oils; odor and taste somewhat terebinthinate.

Constituents.—Chiefly abietic anhydride.

Uses.—Mainly for ointments and plasters.

Off. Prep.—Ceratum Resinæ; Ceratum Resinæ Composition.

Copaiba Resin.—Resina Copaibæ, U. S. '90.—Obtained from the Oleoresin of Copaiba by distilling off the volatile oil.

Amorphous, yellowish, or brownish-yellow brittle masses, soluble in alcohol, ether, carbon disulphide, benzol, and the volatile oils; odor similar to that of the oleoresin; the alcoholic solution is acrid and bitter, and acid in reaction.

Composition.—Chiefly mixture of copaivic and metacopaivic acids.

Uses.—Same as those of the oleoresin, which see.

To the **Natural** Resins belong Guaiac and Mastic.

Unofficial: Elemi, Amber and the following used almost exclusively for varnishes: Copal, Dammar, Sandarac, Lac and Asphalt.

Guaiac.—Guaiacum, U. S.—Guaiaci Resina, U. S., '90.—Product of Guaiacum officinale, and G. sanctum, West India and South American trees, belonging to the Zygophyllaceæ. It is most abundant in the heart-wood.

Obtained partly as natural exudation, partly from incisions in the trunks of living trees, and partly by setting fire to billets of wood that have been channeled on one side, the resin as it fuses flowing out along the groove.

In tears of irregular masses; in thin pieces, transparent lustre vitreous, fracture brittle and somewhat conchoidal, color greenish or reddish-brown, soluble in alcohol and caustic potassa, but not in oil of turpentine or benzene. The powder is whitish, but soon turns green on exposure to the air, and in the presence of water assumes variegated colors.

Composition.—Complex, consisting of guaiacic acid, guaiac yellow, guaiaretic acid, betaresin, a small proportion of gum, ash, etc.

Uses.—Stimulant, diuretic and alterative, sometimes in the form of Mixture or Emulsion. **Dose** 1 Gm.

Off. Prep.—Tinctura Guaiaci; Tinctura Guaiaci Ammoniata and Pil. Antimonii comp., formerly official.

Mastic.—Mastiche, U. S.—Product of Pistacia Lentiscus. Anacardiaceæ, a small tree, indigenous to the basin of the Mediterranean. Obtained from vertical incisions into the bast layer of the trunk and larger branches.

Rounded or elongated tears about the size of peas, brittle, with a conchoidal fracture, transparent, of a light yellow color, partly soluble in alcohol, entirely so in ether and the volatile oils, the alcoholic solution acid in reaction, odor faintly balsamic, taste somewhat terebinthinous, softening in the mouth.

Constituents.—Mastichic acid, about 90%, soluble in alcohol; Masticin, soluble in hot alcohol; and a trace of volatile oil.

Uses.—Mild astringent and **Masticatory**; also for varnishes and cements.

Off. Prep.—Pilulæ Aloes et Mastiches.

Elemi.—A resinous exudation obtained from various sources:

Manila Elemi, exudation from Canarium commune, Nat. Ord. Burseraceæ.

Brazilian Elemi, from Icica Icicariba and other species of the same genus.

Mexican Elemi, supposed to be the product of Amyris elemifera; and

Mauritius Elemi, from Colophonia Mauritiana.

Manila Elemi is the most important. Crystalline, yellowish, soft, friable when old, taste pungent, disagreeable, bitter; odor aromatic, balsamic.

Composition.—Volatile oil, elemic acid, crystalline, and amorphous resins.

Uses.—Stimulant and irritant; externally in ointment and plasters.

Copal Resin.—Chiefly found fossil in Zanzibar and other parts of Africa, but is also obtained from various tropical leguminous trees.

Large irregular pieces, usually finely verrucose at the surface, hard transparent or translucent, resembling amber; inodorous, tasteless, difficultly fusible.

Constituents.—Several different resins.

Dammar Resin, or Dammara.—Obtained from two different species of coniferous trees, Dammara Orientalis, East Indies; and Dammara Australis, New Zealand. It is a spontaneous exudation.

The New Zealand Dammar or "**Kauri Gum**" sometimes occurs **fossil**.

Roundish, transparent, yellowish, inodorous, tasteless masses, of a glossy, conchoidal fracture, not so hard as copal, melts above 100°C., is somewhat soluble in alcohol, but more so in chloroform and benzene.

Constituents.—Several different resins.

Uses.—Sometimes in preparation of plasters, more commonly for **varnishes**.

Sandarac Resin, or Sandarac.—Spontaneous exudation from the stem of a small African tree, Callitris quadrivalvis; Coniferæ.

Resembles mastiche and is sometimes used to adulterate it. It differs in occurring in more elongated tears, in becoming powdered when masticated, and in being almost completely soluble in alcohol.

Three different resins and a bitter principle soluble in water.

Shellac, or Lacca.—Product of a variety of East Indian and a few Mexican plants. An exudation produced by the puncture of a hemipterous insect, the female of Coccus lacca. The lac of commerce comes chiefly from India, and the most important trees which produce it are a spurge, the Aleuritis laccifera, and a fig, the Ficus Indica.

Lac occurs in the following forms: **Stick lac** consists of the thin twigs of the tree covered with the resinous exudation. **Seed lac**, of the glossy fragments that have been detached from the twigs; and **Lump lac**, that obtained by boiling the stick or seed lac with water, and melting the product into cakes.

Shellac, of reddish or orange colored, transparent flakes, brittle, tasteless and glossy, and produced in the same way as lump lac, only dried or hardened in thin plates instead of in masses.

Constituents.—Complex; five different resins, and some coloring matter.

Uses.—Chiefly in the preparation of **varnishes** and **sealing wax**.

Amber, or Succinum.—Fossil product of an extinct coniferous tree, Pinitis succinifer, and probably also of other species. Obtained principally from the shores of the Baltic where it is cast up by the waves.

Hard, brittle, transparent, or translucent, yellowish or reddish-brown irregular masses; melts at 288°C., and at that temperature gives off succinic acid. Insoluble in alcohol, ether, or the volatile oils, sparingly soluble in chloroform.

Constituents.—Various resins and succinic acid.

Uses.—Source of oil of amber and **succinic acid.**

Asphalt, or Asphaltum, like amber, is a fossil resin.

A petroleum product, which forms extensive deposits in some parts of the world, as in the Island of Trinidad and Utah. Used for **varnishes.**

GUM-RESINS AND BALSAMS.

The Gum-Resins comprise those milky exudations of plants which contain a Gum **soluble** in water and a Resin **insoluble** in water but soluble in alcohol. Some also contain **volatile oil.** They may, therefore, be conveniently divided into two groups:

(1) Those which contain **volatile oil:**

Asafetida and Myrrh are official. Ammoniac, Galbanum, Bdellium, Olibanum, Opoponaxa nd Sagapenum are unofficial.

(2) Those which do **not contain** volatile oil are:

Gamboge, Scammony and Elastica, official; Euphorbium, unofficial.

Asafetida.—Asafœtida, U. S.—Exudation product from Ferula fœtida, Regel and other species of Ferula; Umbelliferæ. Native of Afghanistan and Turkestan. Obtained by making incisions in the root.

It occurs in the form of **tears,** more or less agglutinated in masses, also as **Amygdaloid** asafœtida, irregular pieces of tears imbedded in a sticky yellowish or brownish gray mass, more or less impure from vegetable fragments and earthy matters. When the mass is freshly broken the tears are white, on exposure changing to pink and then to brown.

Liquid asafœtida is a sticky semifluid, more or less impure mass, at first light-colored but gradually turning brown on exposure.

Stony asafœtida is a very impure variety, consisting of a little of the gum-resin mixed with a large proportion of **calcium sulphate** and other impurities.

Of a strong alliaceous odor and bitter, acrid taste; it forms a milky emulsion with water, which turns yellowish with ammonia water. Asafœtida should yield not less than 50 per cent matter soluble in alcohol.

Composition.—Gum 20 to 30 per cent, resin 50 to 70 per cent, 3 to 9 per cent volatile oil and various impurities.

Uses.—Stimulant, antispasmodic, expectorant, laxative.

Dose.—0.25 Gm.

Off. Prep.—Emulsum Asafœtidæ, Pil. Aloes et Asafœtidæ; Pil. Asafœtida; Tinctura Asafœtidæ.

Myrrh.—Myrrha, U. S.—Spontaneous exudation from bark of

Commiphora Myrrha, Engler; Burseraceæ, a tree inhabiting Arabia and Northeastern Africa.

Dusty, reddish or yellowish-brown masses of irregular tears, odor aromatic, taste bitter, acrid. It yields a brownish-yellow emulsion with water, its alcoholic solution acquires a purple coloration with nitric acid.

Composition.—Gum 40 to 60 per cent, resin 25 to 40 per cent, volatile oil, bitter principle and ash.

Uses.—Stimulant, expectorant, emmenagogue.

Dose.—0.5 Gm.

Off. Prep.—Mistura Ferri composita; Pilulæ Aloes et Myrrhæ; Tinctura Aloes et Myrrhæ; Tinctura Myrrhæ.

Bdellium.—Similar to myrrh. Product of Balsamodendron Mukul, a native of East India and West Africa.

It is best distinguished from myrrh by testing the tincture with nitric acid. Myrrh acquires a purple hue while bdellium does not. Used mostly in plasters.

Olibanum or Frankincense.—Exudes from incisions made in bark of Boswellia Carterii and other species of the same genus, Nat. Ord. Burseraceæ. The trees are natives of Arabia and Eastern Africa.

Light red or yellowish, translucent, externally dusty tears of variable size and shape, softens when held in the mouth, of a bitterish and balsamic taste and odor. Lump olibanum is less pure, being gathered from the ground.

Composition.—Gum 30 per cent, resin 70 per cent, volatile oil and a bitter principle.

Uses.—Chiefly for plasters and **fumigations**, sometimes internally. Expectorant, tonic, stimulant.

Ammoniac.—Ammoniacum, U. S.—'90.—Spontaneous exudation product from stem of Dorema Ammoniacum, Don; Umbelliferæ.

Distinct or agglutinated tears, light yellowish-brown externally, milk-white internally, softens by the heat of the hand; has a bitter and disagreeable acrid taste, and with water forms a milk-white emulsion.

A form which comes in cakes and consists of tears imbedded in a brown mass; is too impure for medicinal use.

Composition.—Gum 18 to 28 per cent, resin about 70 per cent, volatile oil from ½ to 4 per cent.

Uses.—Expectorant and stimulant.

Prep.—Empl. Ammoniac c. Hydrarg., Emulsum Ammoniaci.

Opoponax gum-resin. Product of another umbelliferous plant, a native of Southern Europe, the Opoponax Chironium is obtained by making incisions in root or lower part of stem.

Irregular masses, angular or rounded, friable, reddish or yellowish brown, odor disagreeable, taste balsamic, bitter. Similar in properties and uses to ammoniac.

Galbanum.—Galbanum.—Spontaneous exudation from stem of Ferula galbaniflua and other species of the same genus of Umbelliferous plants. There are two kinds: in tears and lump galbanum.

The **tears** are small, from the size of a pin-head to that of a pea or larger, mostly agglutinated into a hard mass. Yellowish-brown or greenish-brown

outside, whitish or yellowish inside, peculiar balsamic odor, acrid bitterish taste. Treated with alcohol and then with chlorhydric acid, it turns purplish.

Lump galbanum sometimes incloses tears, is sometimes soft, has a somewhat different color and does not change color by alcohol and chlorhydric acid. Probably derived from a different species of plant.

Composition.—Gum 20 per cent, resin 66 per cent, volatile oil 6 to 9 per cent.

Uses.—Antispasmodic, stimulant, expectorant.

Preps.—Emplastrum Asafœtidæ, Emplastrum Galbani, Pilulæ Galbani compositæ, official U. S. Ph. '80.

Gum-Resins Containing No Volatile Oil.

Gamboge.—Cambogia, U. S.—Obtained by making incisions into the bark of Garcinia Hanburii, Guttiferæ, a small tree native to Cochin China, Cambodia and Siam.

Sticks cylindrical, sometimes hollow; surface striated from the impressions of the bamboo, in the hollow stems of which the gum resin is collected; fracture smooth, conchoidal, orange red in color, inodorous, taste unpleasantly acrid, dust sternutatory. A good quality yields a bright **yellow powder** and also a bright yellow **emulsion** when triturated with water.

Composition.—Gum 16 to 20 per cent and resin about 80 per cent.

Uses.—With other medicines as a hydragogue cathartic.

Dose.—0.125 Gm. (2 grains).

Off. Prep.—Pilulæ Catharticæ compositæ.

Scammony.—Scammonium, U. S.—Dried milk-juice of Convolvulus Scammonia, Convolvulaceæ, a native of Western Asia. Obtained by cutting off the top of root and collecting the milk-juice.

Dark greenish or blackish irregular masses, or regular cakes, breaking with an angular fracture, a resinous lustre; the powder has a greenish cast and yields with water a dark greenish **emulsion**; odor cheeselike, taste acrid.

Composition.—Gum 5 to 15 per cent, resin 80 to 90 per cent, and various impurities. Liable to be adulterated with starch, chalk and with various resins.

Uses.—As hydragogue cathartic.

Dose.—0.250 Gm. (4 grains).

Off. Prep.—Resina Scammonii.

Rubber.—Elastica, U. S.—Caoutchouc.—The prepared milk-juice of Hevea brasiliensis and of various other species of Hevea. Euphorbiaceæ; known in commerce as Para Rubber.

Obtained by evaporation of the milk-juice and exposing the semi-solid to fire and smoke until hard masses or "Hams" are formed.

Brown or brownish-black, internally lighter colored, insoluble in water, dilute acids, solutions of alkalies or alcohol; soluble in chloroform, carbon disulphide, oil of turpentine, benzin and benzene. It is lighter than water; melts at 125°C., and at this temperature dissolves in Petrolatum.

Uses.—Its solution in Chloroform as a **cement** and sometimes as a sur-

gical dressing. The 50 per cent solution in Petrolatum with Lead Plaster for **Rubber** Adhesive Plaster.

Mixed with Sulphur and heated it is rendered insoluble and unaffected by heat, **vulcanized**; useful for the construction of surgical appliances, etc.

Off. Prep.—Emplastrum Adhesivum.

Euphorbium.—Exudation from incisions in the stem of Euphorbia resinifera, a cactus-like shrub, native to the mountains of Morocco.

Dull brownish yellow, somewhat translucent, globular, conical or irregular masses, dust violently sternutatory, taste very acrid. Not completely soluble in any simple solvent; does not completely emulsify in water.

Composition.—Gum 18 per cent, euphorbion and another resin, malates, and various impurities.

Uses.—Externally as rubefacient, **vesicant** and suppurant. If taken internally it acts as a violent and dangerous purgative and **emetic**.

The Balsams.

The term balsam is frequently used in a loose, general sense to designate certain resins, oleoresins and various mixtures, differing widely in composition and properties, but supposed to possess healing virtues.

The term is here restricted to those liquid, semi-liquid or solid vegetable products that contain, in addition to a **resin** or **oleoresin**, benzoic or cinnamic acids, or both.

The official Balsams are Benzoin, Peru, Tolu and Styrax.

Benzoin.—Benzoinum, U. S.—A balsamic resin obtained from Styrax Benzoin, a tree native to Sumatra, Java and Siam. Exudes from incisions made through bark of tree.

Several varieties, the better consisting of opaque, milk-white tears, agglutinated in masses, the mass being yellowish or grayish-brown, but inferior kinds contain few tears and a large proportion of bark and chips of wood.

Sumatra Benzoin, in brown-gray masses, containing a variable proportion of milky-colored tears.

Siam Benzoin, in red-brown translucent masses with few or many tears and an agreeable **vanilla-like** odor.

Penang Benzoin, sometimes very similar to the Sumatra variety, but at other times more resembling storax in appearance and odor.

It is almost wholly soluble in 5 parts of warm alcohol and in solutions of the fixed alkalies.

Composition.—Benzoic and cinnamic acids, various resins, and, in some varieties, vanillin. Cinnamic acid is sometimes absent.

Uses.—Stimulant, expectorant. As a source of Benzoic acid by **sublimation**; also in the preparation of pastiles, **dentifrices** and perfumes.

Dose.—1 Gm.

Off. Prep.—Adeps Benzoinatus, Tinctura Benzoini, Tinctura Benzoini composita.

Balsam of Peru.—Balsamum Peruvianum, U. S.—Derived

from Toluifera Pereiræ, Baillon, a tree growing in West Brazil, northwestern coast of South America and Central America.

Molasses-colored, semi-liquid, red-brown, and transparent when seen in thin layers; sp. gr. 1.14 to 1.150; odor agreeable, aromatic, somewhat smoky; taste, warm, bitterish, afterward acrid. Completely soluble in absolute alcohol, chloroform or glacial acetic acid; only partially soluble in ether and petroleum benzin; completely soluble in 5 parts of alcohol with slight opalescence.

Composition.—Benzoic and cinnamic acids, benzylic benzoate and cinnamate, benzylic alcohol and resin.

Adulteration.—Alcohol, fixed oils, copaiba, turpentine, rosin, etc. [For tests of purity see U. S. Ph.]

Uses.—Externally as **ointment**; internally, stimulant and expectorant; also as a basis for **perfumes.**

Dose.—1 Gm.

Balsam of Tolu.—Balsamum Tolutanum, U. S.—Product of a Leguminous tree, Toluifera Balsamum, L. A native of Central America, Venezuela, and New Granada; obtained by scarifying the bark of the trees and collecting the exudation in "calabashes."

Liquid or semi-liquid when fresh, hardening with age, but still readily softening in the mouth, yellowish or reddish-brown in color, in thin layers transparent; when examined microscopically, showing crystals of cinnamic acid; odor agreeably aromatic, somewhat resembling vanilla; taste aromatic; completely soluble in alcohol and chloroform, solutions of fixed alkalies and almost so in ether, but insoluble in carbon disulphide and petroleum-benzin.

Composition.—Benzoic and cinnamic acids, two resins differing in their solubility in alcohol, toluene, and benzylic benzoate and cinnamate.

Adulterations.—Turpentines, detected by sulphuric acid, which turns pure tolu balsam a cherry red, but bleaches that which contains turpentine.

Uses.—Expectorant, stimulant. Used by **perfumers,** and in the manufacture of pastiles.

Dose.—1 Gm.

Off. Prep.—Syrupus Tolutanus; Tinctura Benzoini comp.; Tinctura Tolutana.

Storax.—Styrax, U. S.—Product of the Liquidamber Orientalis. Hamamelidaceæ, indigenous to Asia Minor. Extracted from the inner bark of the tree by boiling in water.

Consistency of thick syrup; opaque from containing finely divided particles of water, separated by standing into two layers, one heavier and darker colored, the other lighter and containing most of the water; odor strong, agreeable, balsamic. Soluble in alcohol, ether, and carbon disulphide, insoluble in cold petroleum benzin, but hot benzin dissolves out the styracin and cinnamic acid which are deposited in crystals on cooling.

Composition.—Benzoic and cinnamic acids, styracin, storesin, resins, etc.

Uses.—Stimulant, diuretic, expectorant; in Tinctura Benzoini Composita.

Dose.—1 Gm.

Liquidamber styraciflua, the "Sweet Gum Tree," of the Southern United States, exudes a similar balsam. It is usually solid.

Dragon's Blood.—Resina Draconis.—Exudation from ripening fruit of Dæmonorops Draco, a species of Palm, native to the Malay Archipelago.

Solid, dark, red-brown, in tears, rounded masses, sticks, or irregular cakes, transparent in thin pieces, aromatic, and with a benzoin-like odor when heated; readily soluble in alcohol, benzol and turpentine.

Composition.—Resins, benzoic or cinnamic acid. Sometimes the one and sometimes the other acid is present, and sometimes both are wanting.

Uses.—Astringent, stimulant. Employed for coloring varnishes and tinctures, and in plasters.

Balsam Acids.

Benzoic Acid.—$HC_7H_5O_2$.—Acidum Benzoicum, U. S.—A monobasic acid obtained by **sublimation** from Benzoin, or produced artificially from Toluol.

By sublimation only about 8% of the acid is obtained, a nearly equal amount left in the benzoin being produced by boiling the residue with milk of lime, filtering and supersaturating the hot filtered liquid with Hydrochloric Acid. The crystals are purified by solution in hot alcohol and filtration through animal charcoal, or by sublimation.

Soluble in 281 parts of water, in 15 parts of boiling water, and in 1.8 parts of alcohol; completely volatilized without change when heated on platinum foil; heated with 3 parts of quicklime in a test tube, it evolves the odor of benzene.

Uses.—In medicine chiefly in genito-urinary diseases; also as an **antiseptic** in surgery.

Dose.—0.5 Gm.

Cinnamic Acid.—$HC_9H_7O_2$.—An acid quite similar to Benzoic Acid is derived chiefly from Cinnamon Oil, which consists of cinnamic aldehyde.

RESINOUS DRUGS, GROUP V.

This group includes those vegetable drugs whose virtues are chiefly or wholly due to the presence of an acrid or bitter resin, or to extractive matter, either associated or not with a volatile or acrid fixed oil.

Some few contain glucosides, alkaloids, or other principles, but these are not regarded as being of any considerable medicinal importance.

The Resinous drugs require **alcoholic** menstrua for extraction and like the aromatic drugs their preparations precipitate with water. The process for preparing the Resin of Podophyllum, by pouring a concentrated alcoholic Tincture of the drug into Water, is one of the best illustrations of their behavior when mixed with water or aqueous liquids. This pharmaceutical incompatibility may be modified or prevented by the intervention of Sugar or Mucilage, which serves to suspend the resinous matter in liquid mixtures.

Arnica Flowers.—Arnicæ Flores, U. S.—Flowers of Arnica montana, L. Nat. Ord., Compositæ. Constituents: Vol. oil,

inulin, both tasteless and acrid resins, arnicin, etc. Off. Prep.: Tinctura Arnicæ Florum.

Aspidium.—Aspidium, U. S.—Rhizome of Dryopteris filix mas, and of Dryopteris marginalis, Gray. Filices. Constituents: Fixed oil, six per cent; filicic acid, filitannic acid, etc. Off. Prep.: Oleoresina Aspidii.

Uses.—For the removal of **tapeworm,** ten to twenty minims of the Oleoresin, administered upon a fasting stomach, and followed with a purgative.

Buchu.—(See Group 4.)

Cusso.—Cusso, U. S.—Brayera, '80.—Kousso. Female inflorescence of Hagenica Abyssinica, Gmelin. Rosaceæ. Constituents: Bitter acrid kousinresin about six per cent, tannin and tasteless resin. Off. Prep.: Fluidextractum Cusso.

Uses.—For the removal of **tapeworm,** either alone or combined with other agents in the form of **Infusion** which **should not be strained.**

Indian Cannabis.—Cannabis Indica, U. S.—Flowering tops of a female plant of Cannabis sativa, L. Moraceæ. Constituents: Volatile oil, several resins and alkaloids. Off. Prep.: Extractum Cannabis Indicæ; Fluid extractum Cannabis Indicæ; Tinctura Cannabis Indicæ.

Uses.—**Cannabin Tannate** is a compound of the active principle with tannic acid, and is said to represent the medicinal virtues of "Indian Hemp."

Dose.—0.065 Gm. (1 grain).

Cascara Sagrada.—Rhamnus Purshiana, U. S.—The bark of Rhamnus Purshiana, De Candolle. Rhamnaceæ. Used only one year after collection. Constituents: Several resins. Off. Prep.: Extractum Rhamni Purshianæ; Fluidextract Rhamni Pursh.; Fl'ext. Aromaticum.

Uses.—As a gentle laxative especially in **habitual** constipation. Also used in the form of Infusion and Extract representing four times the drug. The so-called **tasteless** preparations made by treating the drug with magnesia previous to extraction are represented by the official Aromatic Fluidextract.

Dose.—1 Gm.

Chamomile.—Anthemis, U. S.—Flower heads of Anthemis nobilis. Compositæ. Constituents: Vol. oil, bitter principle, etc.

Uses.—An ingredient in Bitters for domestic use; also as Infusion.

Cimifuga.—Cimifuga, U. S.—Black Snakeroot. Rhizome and rootlets of Cimicifuga racemosa, Nuttall. Ranunculaceæ. Constituents: Resin, acrid principle, and a peculiar acid. Off. Prep.: Extractum Cimicifugæ; Fluidextractum Cimicifugæ; Tinctura Cimicifugæ.

Uses.—Cimicifugin, or **macrotyn,** a resinoid prepared by precipitating the alcoholic tincture in water, washing, drying and powdering.

Dose.—1 Gm.

Cotton Root Bark.—Gossypii Cortex, U. S.—Bark of root of Gossypium herbaceum, L., and other species of Gossypium. Malvaceæ. Constituents: Resins, coloring matter, fixed oil, and a peculiar principle similar to tannin. Off. Prep.: Fluidextractum Gossypii Corticis.

Uses.—Liquid preparations of cotton-root bark are liable to gelatinize, which may be prevented by using **alcohol** as a menstruum.

Dose.—2 Gm.

Cubeb.—(See Group 4.)

Cypripedium.—Cypripedium, U. S.—Ladies' Slipper.—Rhizome and rootlets of Cypripedium hirsutum, Miller, and C. parviflorum, Salisbury. Orchidaceæ. Constituents: Volatile oil, resins, etc. Off. Prep.: Fluidextractum Cyrripedii.

Dose.—1 Gm.

Eucalyptus.—(See Group 4.)

Frangula.—Frangula, U. S.—Buckthorn.—Bark of Rhamnus frangula, L. Rhamnaceæ. (Should not be used till one year after collection.) Constituents: Resin, bitter principle, emodin and frangulin. Off. Prep.: Fluidextractum **Frangulæ.**

Dose.—1 Gm.

Ginger.—(See Group 4.)

Grindelia.—Grindelia, U. S.—Leaves and flowering tops of Grindelia robusta, Nuttall (and G. squarrosa, Dunal). Compositæ. Constituents: Volatile oil, resin, and bitter extractive. Off. Prep.: Fluidextractum Grindeliæ.

Dose.—2 Gm.

Hamamelis Leaves.—Hamamelidis Cortex, U. S.—Witch Hazel.—Leaves of Hamamelis Virginiana, Linne. Hamamelidaceæ. (Should be collected in autumn while still green.) Constituents: Tannin and bitter extractive. Off. Prep.: Fluidextractum Hamamelidis Foliorum.

Hamamelis Bark.—Hamamelidis Cortex, U. S.—From same source as the Leaves.

Uses.—For the preparation of Distilled Extract of Witch Hazel by distillation with water, **Aqua Hamamelidis.,** U. S.

Jalap.—Jalapa, U. S.—Tuberous root of Exogonium purga, Bentham, Convolvulaceæ. Constituents: Resin, of which it should contain not less than 8 per cent. Off. Prep.: Extractum Jalapæ; Pulvis Jalapæ Compositus; Resina Jalapæ.

Uses.—Resin of Jalap or "Jalapin" is soluble in ether to the extent of ten per cent. The insoluble portion is termed convolvulin, and represents

the medicinal virtue of Jalap. The principal use of Jalap is in the form of resin in **Comp. Cathartic Pills.**

Dose.—1 Gm.

Lappa.—Lappa, U. S.—Burdock.—Root of Arctium Lappa, L. Compositæ. Constituents: Inulin, bitter extractive, mucilage, resin. Off. Prep.: Fluidextractum Lappæ.

Uses.—A tincture of Burdock fruit, twenty per cent, with seventy per cent alcohol, as an internal remedy in certain skin diseases.

Dose.—2 Gm.

Lupulin.—Lupulinum, U. S.—Glandular trichomes separated from the Fruit of Humulus lupulus. Moraceæ. Constituents: Volatile oil three per cent, resin, lupamaric acid, etc. Off. Prep.: Fluidextractum Lupulini; Oleoresina Lupulini.

Uses.—Chiefly in **pills**; made into a mass by the addition of a little ether.

Dose.—0.5 Gm.

Marrubium.—(See Group 4.)

Matico.—Matico, U. S.—Leaves of Piper Augustifolium, R. & P. Piperaceæ. Constituents: Volatile oil one and a half per cent, pungent resin, artanthic acid, tannin. Off. Prep.: Fluid extractum Matico; Tinctura Matico and an unofficial Infusion.

Matricaria.—Matricaria, U. S.—German Chamomile.—Flower heads of Matricaria Chamomilla, L. Compositæ.

Constituents.—Volatile oil one-fourth per cent, anthemic acid, anthemidin, bitter extractive.

Uses.—As a substitute for English or Roman Chamomile, to which, however, it is said to be inferior.

Mezereum.—Mezereum, U. S.—Bark of Daphne Mezereum, L., and other species of the same genus. Thymeleaceæ. Constituents: Soft acrid resin, daphnin and volatile principle. Off. Prep.: Decoctum Sarsaparillæ compositum; Fluid extractum Sarsaparillæ compositum; Extractum Mezerei.

Mezereum, when being powdered, produces a very **irritating** dust; it may be prevented by sprinkling a little alcohol upon the bark.

Dose.—0.5 Gm.

Phytolacca.—Phytolaccæ, U. S.—Poke Root. Root of Phytolacca decandra, L., Phytolaccaceæ. Constituents: Acrid principle, resin, tannin, etc.

Neither is much employed except by physicians of the Eclectic School.

Dose.—0.125 Gm.

Podophyllum.—Podophyllum, U. S.—May Apple. Rhizome and rootlets of Podophyllum peltatum, L., Berberidaceæ. Constituents: Resin five per cent. Off. Prep.: Extractum Podophylli; Fluidextractum Podophylli; Resina Podophylli.

Uses.—Chiefly in the form of Resin, or **Podophyllin**, in pills, either alone

or combined with other cathartics or agents to modify its action.

Dose.—0.5 Gm.

Pumpkin Seed.—Pepo, U. S.—Seeds of Cucurbita Pepo, L., Cucurbitaceæ. Constituents: Fixed oil forty-four per cent, acrid resin.

Uses.—**Emulsion** as a **tænifuge**; two to four ounces are beaten with some sugar and triturated with water or milk; it should **not be strained**, as, according to some authorities, its efficiency in expelling the worms is due to the perisperm of the seed, which would be rejected by straining.

Pyrethrum.—Pyrethrum, U. S.—Pellitory. Root of Anacyclus Pyrethrum, De Candolle. Composite. Constituents: Acrid resin, bitter principle, inulin, fixed oil. Off. Prep.: Tinctura Pyrethri.

Uses.—As an ingredient in **Toothache Pills.** The ground flowers of Pyrethrum roseum, known as "**Persian Insect Powder,**" for the destruction of insects.

Sabal.—Sabal.—U. S.—Saw Palmetto.—Fruit of Serenoa Serrulata, Hooker, fil, Palmæ. Constituents: Volatile and fixed oil, resin, etc.

Uses.—As a Diuretic-Prep. Fluidextract.

Dose.—1 Gm.

Savine.—Sabina, U. S.—Leafy tops of Juniperus Sabina, L., Coniferæ. Constituents: Volatile oil two per cent, resin, tannin. Off. Prep.: Fluidextractum Sabinæ.

Scutellaria.—(See Group 10.)

Serpentaria.—Serpentaria, U. S.—Virginia Snake root. Rhizome and rootlets of Aristolochia Serpentaria, Linne, and A. reticulata, Nuttall. (Texas.), Aristolochiaceæ. Constituents: Volatile oil one-half per cent, bitter principle, tannin. Off. Prep.: Fluidextractum Serpentariæ; Tinctura Cinchonæ compositæ; Tinctura Serpentariæ.

Dose.—1 Gm.

Stillingia.—Stillingia, U. S.—Queen's Root. Root of Stillingia sylvatica, L., Euphorbiaceæ. Constituents: Pungent acrid resin, fixed oil, tannin, starch. Off. Prep.: Fluidextractum Stillingiæ

Uses.—In **Compound Syrup Stillingia,** Am. Disp. (Nat. Form.). The medicinal value of Stillingia is due chiefly to the **oil**; since this is insoluble in water the syrup is more or less cloudy. The Compound Fluid Extract should not yield a clear mixture with water, as in that case it must be nearly **inert.**

Dose.—2 Gm.

Xanthoxylum.—Xanthoxylum, U. S.—Prickly Ash. Bark of Xanthoxylum Americanum, Miller, and of X. Clava-Herculis, L., Rutaceæ. Constituents: Bitter principle, acrid oil, both acrid and tasteless resin, tannin. Off. Prep.: Fluidextractum Xanthoxyli.

Dose.—2 Gm.

SPECIES—TEA MIXTURES.

Mixtures of various drugs coarsely comminuted by slicing, or bruising in an iron mortar, mixed often with aromatic drugs in their whole form, are called **Species.**

The following are mixtures of drugs, most of which are included in the foregoing groups:

Breast Tea.—Species Pectorales: Althæa, 8; Glycyrrhiza, Russian, peeled, 3; Orris, 1; Coltsfoot, 4; Mullein flowers, 2, and Anise (star), 2 parts. Contuse and mix.

Laxative Tea.—Species Laxantes: Senna, 16; Elder flowers, 10; Fennel, 5, Anise, 5, and Potassium Bitartrate, 4 parts. To the Senna (cut) add the potassium bitartrate, then the other ingredients, and mix the whole thoroughly.

Wood Tea.—Species Lignorum, "Blood-purifying Tea." Guaiac wood, 5; Ononis (Rest-harrow root), 3; Glycyrrhiza, Russian, peeled, and Sassafras each, one part; mix.

Fumigating Powder.—A mixture of Lavender, Rose, Rosemary, Orris, etc., in various proportions, for incinerating in sick chambers, etc.

UNOFFICIAL RESINOUS DRUGS—GROUP FIVE.

Com. Name.	Bot. Name.	Part Used.	Constituents Besides Resin.
Absinthium.	Artemisia A.	Herb.	Vol. oil absinthin.
Actæa.	Actæa spicata.	Root.	Acrid principle.
Aletris.	Aletris farinosa.	R'zome.	Bitter principle.
Apocynum (Dog's bane).	A. androsæmifolium.	R'zome & Root.	Bitter principle, etc.
Arbor Vitæ.	Thuja Occidentalis.	Tops.	Vol. oil, tannin.
Azedarach.	Melia A.	Root b'k.	Bitter resin.
Bela.	Aegle Marmelos.	Fruit.	Bit. prin., tan., vol. oil.
Blue Cohosh.	Caulophyllum thalictroides.	R'zome.	Acrid prin., acid.
Blue Flag.	Iris versicolor.	R'zome.	Vol. oil, acrid res.
Canella.	(See Group 4).		
Cannabis Am.	C. sativa.	Fl. h'b.	Resins, vol. oil.
Chelone.	Chelone glabra.	Herb.	Bitter principle.
Collinsonia.	C. Canadensis.	R'zome.	Bitter principle.
Coltsfoot.	Tussilago farfara.	Herb.	Bit. prin., tan., muc'lg.
Damiana.	Turnera microphylla.	Leaves.	Bit. prin., vol. oil, resin.
Dioscorea.	Dioscorea villosa.	R'zome.	Acrid principle.
Dracontium.	Symplocarpus fœtidus.	R'zome.	Acrid principle.
Drosera (Sun dew).	D. rotundifolia.	Herb.	Acrid resin, etc.
Elecampane.	Inula Helenium.	Root.	Inulin, helenin.
Euphorbia.	E. corollata.	Root.	Acrid resin, etc.
Feverfew.	Pyrethrum Parthenium.	Herb.	Bit. prin., vol. oil.
Garlic.	Allium Sativum.	Bulb.	Vol. oil, muc'lg.
Gnaphalium.	G. polycephalum.	Herb.	Bit. prin., vol. oil.
Guaiac Wood.	Guaiacum officinale.	Heart-wood.	Extractive.
Helianthemum.	H. Canadense.	Herb.	Bit. principle, tannin.
Heraclum.	H. lanatum.	Herb.	Acrid principle, vol. oil.
Hypericum.	H. perforatum.	Herb.	Color, tannin.
Indian Turnip.	Arisæma triphyllum.	Corm.	Volatile acrid principle.
Leonurus.	L. cardiaca.	Herb.	Bit. principle, vol. oil.
Liatris.	L. spicata and species.	Tuber.	Volatile oil.
Lycopus.	L. Virginicus.	Herb.	Bit. prin., vol. oil, tan.
Menyanthis.	M. trifoliata.	Leaves.	Acrid prin., m'ny'thin.
Milkweed.	Asclepias cornuti.	R'zome.	Bit. prin., asclepion tan.
Myrica.	Myrica cerifera.	Bark.	Myricinic acid.
Nymphæa.	Nymphæa odorata.	R'zome.	Bit. prin., muc'lg., tan.
Panax (Ginseng).	Panax quinquefolia.	Root.	Panaquilon.
Pimpernel.	(See Group 4).		
Pleurisy Root.	Asclepias tuberosa.	Root.	Bit. prin., tannin.
Poke Berry.	Phytolacca decandra.	Fruit.	Acrid principle.
Pulsatilla.	Anemone P.	Herb.	Vol. acrid principle.
Ricinus.	Ricinus communis.	Seed.	Acrid prin., fixed oil.
Sabbatia.	S. angularis and spec.	Herb.	Erythrocentaurin.
Senecio (Life root)	Senecio aureus.	H'b & R't	Bit. principle, tannin.
Silphium.	S. laciniatum and spec.	Root.	Resins, vol. oil.
Trillium.	T. erectum and spec.	R'zome.	Acrid principle, etc.
Triosteum.	T. perfoliatum.	R'zome.	Bitter principle, etc.
Turmeric.	(See Group 4).		
Viscum (Mistletoe).	Viscum album.	Herb.	Salts, and fixed oil.
Wintera.	(See Group 4).		

THE TANNINS.

Tannic Acid or Tannin is a substance peculiar to, and widely distributed in many plants. It occurs in various modifications as **gallotannic acids** from Nut-gall, **quercitannic acid** from the Oak, **catechu**- and **kramerotannic acid** from Catechu and Krameria respectively, **cinchotannic acid** from Cinchona and many others.

They are composed of Carbon, Hydrogen and Oxygen in different and various proportions; are usually amorphous and **soluble** in water, alcohol and glycerin; their solutions have weak **acid** reaction and they are **precipitated** by most of the Metallic Salts and the Alkaloids. Boiled with dilute acids they are **split** into glucose and phlobaphene and because of this property they have been regarded as **glucosides.**

They have the property of forming an insoluble compound with **gelatin,** hence their value in the process of **tanning,** the tannin producing with the gelatin of raw hide an impervious, flexible surface upon which the usefulness of **leather** depends. Applied to the skin or mucous surfaces of the human body a similar but milder action causes a contraction of the tissues, a property termed **astringent.** The **therapeutic** use of tannins, or drugs containing them called **Astringent Drugs,** depends upon this property; indicated in irritated or otherwise diseased mucous surfaces.

The tannins are characterized by producing marked **coloration** with Salts of Iron which may be either **green** or **blue-black,** and the different varieties may be distinguished through these variations in color.

Tannic Acid.—$HC_{14}H_9O_9$.—Acidum Tannicum, U. S.—Gallotannic Acid, chemically Digallic Acid, as it is changed into gallic acid through chemical reaction induced by heat and moisture. Prepared from Nutgall by maceration with Water and extraction with Ether.

A light yellowish, amorphous, coarse powder or in spongy masses, nearly odorless and of strongly astringent taste. Soluble in 0.34 part of water, in 0.23 part of alcohol, in 1 part of glycerin with heat, freely soluble in dilute alcohol, almost insoluble in absolute ether, benzol, benzin or chloroform. It produces a **bluish-black** color with ferric chloride and the addition of a little lime water to a one-per-cent solution of it produces a bluish-white flocculent precipitate becoming more copious and deeper blue, finally acquiring a pinkish tint, upon excess of the lime water (distinction from Gallic Acid).

It **precipitates** gelatin and the **alkaloids,** is **incompatible** with metallic salts and forms **explosive** compounds with Potassium Chlorate, etc.

When moist or in solution it forms **Ink** with Iron Salts and should not be brought in contact with iron vessels or spatulas. **Dose**—0.5 Gm. (8 grains).

Off. Prep.—Collodium Stypticum; Glyceritum, Trochisci, Unguentum Acidi Tannici.

Gallic Acid.—$HC_7H_5O_5+H_2O$.—Acidum Gallicum, U. S.—Obtained from Nutgall by the action of moist warm Air, and extracting the mass with hot Water.

Whitish or fawn-colored silky needles, which are without odor and have a slightly astringent taste, soluble in 83.7 parts of cold and three parts of boiling water, in 5 parts of alcohol, in 12 parts of glycerin and 40 parts of ether; very slightly soluble in chloroform, benzol or benzin. It produces a **bluish-black** precipitate with **ferric** salts.

It differs from tannic acid in not being precipitated by a solution of Gelatin except in the presence of gum, in not precipitating Alkaloids and in that it does not color solutions of pure **ferrous** salts.

Dose.—1 Gm. (15 grains).

Unguentum Acidi Gallici, 10%, was formerly official.

Pyrogallol.—$C_6H_3(OH)_3$.—Pyrogallol, U. S.—Acidum Pyrogallicum U. S. Ph., '80.—A triatomic Phenol obtained by the dry distillation of Gallic Acid. It should be kept in dark amber-colored bottles.

Light, white laminæ or needles, acquiring a gray tint on exposure to air and light, soluble in 1.6 parts of water, in 1 of alcohol and 1 of ether.

Uses.—Rarely in medicine; extremely **poisonous.** Chiefly in **Photography.**

ASTRINGENT DRUGS, GROUP VI.

This group comprises drugs that are used in medicine mainly for their **astringent** properties, due chiefly to the presence of **tannic** or **gallic acid,** or both. The astringent principles are often associated with **mucilage,** and many of them are therefore both demulcent and astringent in their properties.

Some of the drugs referred to in this group as Wild Cherry are usually classed as astringent, but as they contain other **active** constituents not astringent it was deemed best to treat of them as indicated.

Of Hamamelis and Hæmatoxylon it may be said that the acids to which their astringency is due, differ quite considerably from the tannic and gallic acids.

In their extraction **alcoholic menstrua** containing **Glycerin** have been found the most effective and to prevent precipitation in the preparations.

Gambir.—Gambir, U. S.—Catechu '90. Extract from leaves and twigs of Ourouparia Gambir, Baillon,—Rubiaceæ.

Reddish-brown or light brown irregular masses, friable, inodorous, very astringent taste; not less than 70% should be soluble in alcohol.

Uses.—In Compound Powders and as a Dye-Stuff.

Dose.—1 Gm.

Off. Prep.—Tinctura Gambir comp.; Trochisci Gambir.

Cherry, Wild.—(See Group 7).

Geranium.—Geranium, U. S.—Cranesbill. Rhizome of Geranium maculatum, L., Geraniaceæ. Constituents: Tannin fifteen per cent. Off. Prep.: Fluidextractum Geranii.

Hematoxylon.—Hæmatoxylon, U. S.—Logwood. Heartwood of Hæmatoxylon Campechianum, L., Leguminosæ. Constituents: Hæmatoxylin, tannin and resin. Off. Prep.: Extractum Hæmatoxyli.

Uses.—As an addition to astringent mixtures, but chiefly for **dyeing** and in the preparation of **Inks.**

Kino.—Kino, U. S.—Inspissated juice of Pterocarpus Marsupium, Roxburgh. Leguminosæ. Constituents: Kino-tannic acid, Kino-red and pectin. Off. Prep.: Tinctura Kino.

Uses.—The Tincture is liable to gelatinization, which is best prevented by the use of **alcohol** as a menstruum.

Dose.—0.5 Gm.

Krameria.—Krameria, U. S.—Rhatany.—Root of Krameria triandra, Ruiz and Pavon (Peruvian) and K. Ixina, L. (Savanilla) or K. argentea, Martius, (Para or Brazilian) Kameriaceæ. Constituents: Kramero-tannic acid about ten per cent, resembles catechin in imparting a **green** color to ferric salts and in forming pyrocatechin by dry distillation; and red coloring matter.

Off. Prep.—Extractum Krameriæ; Fluidextractum Krameriæ; Tinctura Krameriæ.

Dose.—1 Gm.

Nutgall.—Galla, U. S.—Excrescence on Quercus lusitanica, Lamarck, Cupuliferæ, caused by puncture and deposited ova of Gynips Gallæ tinctoriæ, Olivier. Hymenoptera of the class Insecta. Constituents: Tannic acid about sixty per cent, and gallic acid two or three per cent. **Dose**—0.5 Gm.

Prep.—Tinctura Gallæ; Unguentum Gallæ.

Uses.—In the preparation of Tannic and Gallic acids and Inks.

Hamamelis.—(See Group 4.)

Matico.—(See Group 4.)

White Oak.—Quercus, U. S.—Quercus alba '90.—Bark of Quercus alba, L. Cupuliferæ. Constituents: Tannin or quercitannic acid, producing a **blue-black** coloration with ferric salts, but not identical with gallotannic acid; resin and coloring matter.

Uses.—Chiefly in tanning leather.

Pomegranate.—(See Group 7.)

Rubus.—Rubus, U. S.—Blackberry. Bark or root of Rubus villosus, Aiton, and other species Rosaceæ. Constituents: Tannin ten per cent.

Off. Prep.—Fluidextractum Rubi, Syrupus Rubi.

Uses.—As Decoction and Infusion. From the fermented **juice** of the berry, Blackberry Wine and Brandy, useful in summer complaints.

UNOFFICIAL ASTRINGENT DRUGS—GROUP SIX.

COM. NAME.	BOT. NAME.	PART USED.	CONSTITUENTS.
Agrimonia.	A. eupatoria.	Herb.	Tannin 5%.
Alder.	Alnus serrulata.	Bark.	Tannin 4%.
Areca.	A. catechu.	Seed.	Tannin 15%, fixed oil.
Avens.	Geum rivale.	R'zome.	Tannin, bitter prin.
Bistort.	Polygonum bistorta.	R'zome.	Tannin, etc.
Castanea.	C. dentata.	Leaves.	Resin.
Comfrey.	Symphytum officinale.	Root.	Mucilage, tannin.
Diospyros, (Persimmon).	D. Virginiana.	Fruit and bark.	Tannin, sugar, etc.
Hepatica.	H. triloba, H. acutiloba.	Herb.	Tannin, mucilage.
Heuchera (Alumroot	H. Americana.	Root.	Tannin 20%.
Oenotheria, (Evening Primrose)	O. biennis.	Herb.	Tannin, mucilage.
Plantain.	Plantago lanceolata. Plantago major.	Herb.	Tannin, bitter prin.
Prinos (Black Alder).	P. verticillatus.	Bark.	Tann., resin, bit. prin.
Pulmonaria.	P. officinalis.	Herb.	Tann., mucilage, resin.
Rumex.	R. crispus.	Root.	Crysophan.
Spiræa (Hardhack).	S. tomentosa.	Flor. Tops	Tannin, bitter prin.
Statice.	S. limonium var. Carolinianum.	Root.	Tannin, mucilage.
Sumach.	Rhus glabra.	Bark.	Tannin, resin.
Tormentil.	Potentilla tormentilla.	R'zome.	Tannin, kinovic acid.

GLUCOSIDAL DRUGS, GROUP VII.

This group comprises drugs whose virtues depend largely or wholly on the presence of **glucosides** and **neutral** Principles, or on peculiar **organic** Acids.

Some drugs are included under this head whose active principles have not yet been isolated, when there is good reason to believe such active principles are present in the drug.

Included in this Group are a few drugs which possess peculiar characteristics, and are some time classed as **reactionary** drugs.

These contain two or more complex principles, one being an albuminous **ferment**, coagulable and destroyed by heat, but rendered active in the presence of water; the other, a still more complex principle, possessing **glucosidal** or feebly **alkaloidal** properties, and decomposed by the action of the ferment, in the presence of **water**, into various compounds, frequently **volatile**, and quite **active** medicinally.

The term **glucoside** is applied to those organic principles which are readily resolvable into **glucose** and another organic principle, either by the action of mineral Acids, of Alkalies, or of Ferments.

They are nearly all **ternary** compounds, that is, composed of Carbon, Hydrogen and Oxygen, while one is quarternary or **nitrogenized**, viz.: Amygdalin, $C_{20}H_{27}NO_{11}$, and two are **sulphureted** or complex, viz.: Sinalbin, $C_{30}H_{44}N_2S_2O_{16}$, and Sinigrin, $C_{10}H_{18}NS_2KO_{10}$.

They possess either neutral or acid properties, and some form salts or crystalline compounds; nearly insoluble in water, a few sparingly soluble though readily soluble in alcohol.

The English ending **in**, Latin **inum**, has been officially adopted to distinguish them from the alkaloids ending in **ine**, Latin **ina**.

Some of the peculiar Organic Acids found in drugs might be classed as Glucosides, and are so classed by some authorities, because they are separable into glucose and another organic principle, and they are treated of here in that connection. The Neutral Principles are also included in this group, because in the present state of our knowledge of the organic principles it is very difficult to distinguish between these exceedingly complex substances.

THE NEUTRAL PRINCIPLES.

A number of solid crystalline substances obtained from plants are termed **neutral principles**, as they are either neutral or feebly acid and form salts, if at all, with alkalies.

They are composed of Carbon, Hydrogen and Oxygen, are mostly insoluble in water, freely soluble in alcohol and either insoluble or slightly soluble in ether or chloroform.

They differ from Glucosides in not being resolvable into **glucose** and are distinguished from the Alkaloids in that they are **not precipitated** by tannic acid, mercuric potassium iodide or other alkaloid reagents. They are sometimes called "**Bitter principles**" because the bitter taste of the Drugs that furnish them is chiefly due to their presence. Medicinally they are the most active constituents of their respective drugs and many of them produce toxic effects to such a degree that they are classed with the **poisons**.

The following Neutral Principles are official:

Aloin.—Aloinum, U. S.—Obtained from several varieties of Aloes, chiefly Curacao Aloes and varying more or less in chemical composition and physical properties according to the source whence derived. Prepared by extracting the Aloes with acidulated boiling water, concentration and crystallization from warm dilute Alcohol.

Minute acicular crystals, or crystalline powder of yellowish color, soluble in 65 parts of water, in 10 parts of alcohol, sparingly in ether.

Uses.—As an ingredient in **Pills**, usually in conjunction with other cathartics.

Dose.—0.065 Gm. (1 grain).

Off. Prep.—Pilulæ Laxativæ Composita.

Elaterin.—$C_{20}H_{28}O_5$.—Elaterinum, U. S.—Obtained from Elaterium, a substance deposited by the juice of the fruit of Ecballium Elaterium, L. Cucurbitaceæ.

Minute white scales or prismatic crystals, sparingly soluble in ordinary solvents, but soluble in 22 parts of chloroform.

Uses.—In the official 10% Trituration, a more uniform and reliable preparation than the crude drug, the so-called **Clutterbuck's** elaterium.

Off. Prep.—Trituratio Elaterini.

Dose.—0.03 Gm. (½ grain).

Picrotoxin.—$C_{30}H_{34}O_{13}$.—Picrotoxinum, U. S. '90.—Obtained

from the seed of Anamirta paniculata, Colebrooke. Menispermaceæ—"Cocculus Indicus."

Colorless, shining prismatic crystals or crystalline powder, having an intense bitter taste, soluble in 240 parts of water, in 9 parts of alcohol; also soluble in the acids and alkalies, slightly soluble in ether or chloroform.

Uses.—In the form of pills or granules

Dose.—0.001 Gm. (1-65 grain).

Salicin.—$C_{13}H_{18}O_7$.—Salicinum, U. S.—A Glucoside, obtained from several species of Salix and Populus, Salicaceæ, by digestion with Lead Oxide extraction with water, purification by filtration through charcoal and crystallization.

White, silky needles or crystalline powder, soluble in 21 parts of water, in 71 parts of alcohol, almost insoluble in ether or chloroform. It is colored **violet** by ferric chloride and sulphuric acid dissolves it with a **red color.**

Salicin is a true **glucoside**, being composed by a **ferment**, such as emulsin or saliva into saligenin, $C_7H_8O_2$ and glucose, $C_6H_{12}O_6$.

Uses.—As a remedy in **Rneumatism.**

Dose.—1. Gm.

Santonin.—$C_{15}H_{18}O_3$.—Santoninum, U. S.—The inner Anhydride or Lactone of Santonic Acid obtained from Santonica., by boiling Levant Wormseed with Milk of Lime and decomposing the Calcium Santoninate formed with Hydrochloric Acid, solution in hot Alcohol, filtration through charcoal and crystallization.

Colorless, flattened, prismatic crystals, odorless, nearly tasteless but developing a bitter taste, nearly insoluble in water, soluble in 35 parts alcohol, in 2.5 parts chloroform, in 78 parts of ether and soluble in caustic alkalies. It is not affected by exposure to the air but **turns yellow exposed to light** and must be kept in amber-colored vials, or in a dark place.

Uses.—In the official Troches, **Trochisci Santonini,** containing 3 cg. in each. Alkalies impair the effect of Santonin, hence the Sodium Santoninate and the Troches of this, of the U. S. Ph., '80, have been discarded. The dose for children should not exceed 0.65 Gm. (1 grain), and should be followed by a purgative.

Chrysarobin.—Chrysarobinum U. S.—A neutral principle, extracted from Goa Powder, a substance found deposited in the wood of Vouacoupoua Araroba, Druce, Leguminosæ.

A pale orange-yellow powder, darkening on exposure to the air, almost insoluble in water or alcohol, soluble in 150 parts boiling alcohol with a slight residue; readily soluble in boiling benzene and in solutions of alkalies.

Uses.—Externally only in Skin diseases, **Ringworm,** etc.

Dose.—0.03 Gm.

Off. Prep.—Unguentum Chrysarobini.

Strophanthin.—Strophanthinum, U. S.—A Glucoside or mixtures of glucosides, obtained from Strophanthus Kombe, Oliver, Apocynaceæ.

Yellowish white crystalline powder, taste intensely bitter, very soluble in water and in diluted alcohol, nearly insoluble in ether, chloroform and benzene. Ferric chloride to acidulated watery solution produces a red-brown precipitate which turns dark-green.

Uses.—To regulate Heart action.

Dose.—0.0003 Gm.=0.3 mg (1-200 grain).

Vanillin.—$C_8H_8O_3$.—Vanillum, U. S.—Methylproto-Catechuic Aldehyde, obtained from Vanilla or prepared artificially from several orthodihydroxy-benzene derivatives.

Crystalline fine white needles of an acid reaction, vanilla taste, soluble in 100 parts of water, easily soluble in all other solvents.

Uses.—For **Flavoring** purposes.

Dose.—0.03 Gm. (½ grain).

REACTIONARY DRUGS.

The following Reactionary Drugs are official:

Bitter Almond.—Amygdala amara, U. S.—Seed of Prunus Amygdalus var, amara, De Candolle. Rosaceæ. Constituents: Fixed oil about 45 per cent, amygdalin, emulsin, mucilage, sugar, etc.

When brought into contact with water, the ferment **emulsin** decomposes the glucoside **amygdalin** into Hydrocyanic Acid, Oil of Bitter Almond and sugar.

Uses.—Chiefly for preparing **oil** of bitter almond.

Wild Cherry.—Prunus Virginiana, U. S.—Bark of Prunus serotina, Erhart. Rosaceæ. Constituents: Bitter principle, tannin, amygdalin and emulsin. Off. Prep.: Fluidextractum Pruni Virginianæ; Infusum Pruni Virginianæ; Syrupus Pruni Virginianæ.

Wild cherry bark should be collected in the month of October, as it then yields the greatest portion of Hydrocyanic Acid; the thick, corky layer frequently found on old bark should be removed. When moistened with **water,** volatile Oil of Bitter Almond and Hydrocyanic Acid are produced by the action of the **emulsin** upon **amygdalin,** similarly to the reaction of these principles in bitter almond. Since the power of the ferment is destroyed by heat and the products are volatile the maceration and extraction of the powdered bark in preparing the **Infusion** and the **Syrup,** also the solution of the sugar in the latter, should be effected **without heat** and in **covered, non-metallic** vessels.

Dose.—2 Gm.

Black Mustard.—Sinapis Nigra, U. S.—Seed of Brassica nigra, L., Cruciferæ. Constituents: Fixed oil 25 per cent, myrosin, sinigrin, giving rise to volatile oil. Off. Prep.: Charta Sinapis.

Uses.—In coarse powder, or ground, for the preparation of **Cataplasm,** mixed with **cold** water. Black mustard is more irritant than the White, and is therefore frequently mixed with the latter when used to produce **blister.** Mustard seed oil is obtained by expression between hot plates of iron.

Dose.—Emetic 8 Gm.

White Mustard.—Sinapis Alba, U. S.—Seed of Sinapis alba, L., Cruciferæ. Constituents: Fixed oil 20 to 25 per cent; sinalbin and myrosin giving rise to volatile oil.

Uses.—Similar to those of Black Mustard.

Both black and white mustard contain a ferment **myrosin,** and each a glucoside termed respectively **sinigrin** and **sinalbin.** In the presence of water these substances are decomposed by the myrosin, forming volatile compounds, to which the acrid taste and irritant action of both kinds of mustards are due.

In Black Mustard the **Sinigrin** forms **Allyl iso-thiocyanate** or Volatile Oil of Mustard, an exceedingly **irritating** and, when taken internally, **poisonous** substance; some acid potassium sulphate and sugar are also formed.

In White Mustard the **Sinalbin,** also termed Sulphocyanide of Sinapin, is similarly decomposed into Sulphate of Sinapin and Sulphocyanide of Acrinyl, a thick, non-volatile oil, possessing **vesicating** properties. The base of the other compound, **Sinapin,** is an alkaloid.

GLUCOSIDAL DRUGS.

Aloes.—Aloe.—U. S.—The inspissated juice of leaves of several species of Aloes. Liliaceæ. Constituents: Aloin, resin, vol. oil (small quantity). Off. Prep.: Extractum Aloes Aquosum; Extractum Colocynthidis comp.; Pilulæ Aloes; Pil. Aloes et Ferri; Pil: Aloes et Mastiches; Pil. Aloes et Myrrhæ; Pil. Rhei comp.; Tinctura Aloes; Tinct. Aloes et Myrrhæ; Tinctura Benzoini comp.

Aloe Barbadensis, U. S.—'90.—From Aloe vera.

Aloe Socotrina, U. S.—'90.—From Aloe Perryi, Baker.

Aloe Purificata, U. S.—Prepared from Aloes by fusing it on a water-bath, keeping it in a liquid form by the addition of Alcohol, whilst straining it and evaporating it until hard and brittle.

Of the different kinds of Aloes occurring in commerce, viz.: **Barbadoes, Cape Socotrin** and **Curacao,** the Socotrin aloes was formerly regarded as containing the greatest proportion of active principle—aloin—and as being less harsh in its action than the other varieties, but the **Curacao** is perhaps of equal value and is cleaner and cheaper.

Uses.—Chiefly as Purified Aloes, a light golden-yellow powder, an ingredient in many unofficial pills, etc., and in Comp. Powder of Aloes and Canella, **Hiera Picra,** formerly official, consisting of Aloes, **four** parts; Canella, one part, in fine powder.

Dose.—0.25 Gm. (4 grains).

Apocynum.—Apocynum, U. S.—Canadian Hemp. Root of Apocynum Cannabinum, L. Apocynaceæ. Constituents. Apocynin, apocynein, tannin, bitter extractive. Off. Prep.: Fluidextractum Apocyni.

Uses.—In preparing Apocynin, a resinoid.

Dose.—1 Gm.

Calendula.—Calendula, U. S.—Marigold, the florets of Calendula

officinalis, L. Compositæ. Constituents: Vol. oil (trace), calendulin, bitter principle. Off. Prep.: Tinctura Calendulæ.

Uses.—Chiefly as a substitute for **Arnica** in the form of Tincture and Infusion, as an application for sprains and bruises.

Calumba.—Calumba, U. S.—Columbo. Root of Jateorhiza palmata, Miers. Menispermaceæ. Constituents: Columbin, berberine, columbic acid. Off. Prep.: Fluidextractum Calumbæ; Tinctura Calumbæ.

Uses.—As **Infusion,** and in powder associated with other tonics.

Dose.—1 Gm.

Capsicum.—Capsicum, U. S.—Cayenne Pepper. Fruit of Capsicum fastigiatum, Blume. Solanaceæ. Constituents: Volatile oil, capsaicin, resin, etc. Off. Prep.: Fluidextractum Capsici; Oleoresina Capsici; Tinctura Capsici.

Uses.—Chiefly as a **condiment;** as a **rubefacient** in Liniments and Plasters.

Dose.—0.065 Gm. (1 grain).

Chimaphila.—Chimaphila, U. S.—Pipsissewa. Leaves of Chimaphila umbellata, Nuttall. Ericaceæ. Constituents: Chimaphilin, arbutin, ericolin, urson, tannin, etc. Off. Prep.: Fluidextractum Chimaphilæ.

Uses.—As Infusion and as an ingredient in Syrup Stillingia Comp. Am. Disp.

Dose.—2 Gm.

Chirata.—Chirata, U. S.—Entire plant of Swertia Chirayita, Hamilton. Gentianeæ. Constituents: Chiratin (glucoside) and ophelic acid. Off. Prep.: Fluidextractum Chiratæ.

Uses.—Sometimes as Infusion, now seldom used.

Dose.—1 Gm.

Cloves.—(See Group 4.)

Colocynth.—Colocynthis, U. S.—Fruit of Citrullus Colocynthis, Schrader. Cucurbitaceæ. Constituents: Colocynthin, resin, fixed oil, etc. Off. Prep.: Extractum Colocynthidis; Extractum Colocynthidis comp.

Uses.—Chiefly for the preparation of the Extract, and in combination with less drastic purgatives. The fruit should be deprived of the seeds previous to use, because they contain a considerable quantity of **fixed oil** which is undesirable in the preparations. The percentage yield of extract varies considerably, but averages about 20 per cent.

Dose.—0.065 Gm. (1 grain).

Cubeb.—(See Group 4.)

Convallaria.—Convallaria, U. S.—Lily of the Valley, the Rootlets and Rhizome of Convallaria majalis, L. Liliaceæ. Constituents: Convallarin and convallamarin. Off. Prep.: Fluidextractum Convallariæ.

Uses.—As a substitute for Digitalis in heart diseases.

Dose.—0.5 Gm.

Corn Silk.—Zea, U. S.—Fresh Styles and Stigmas of Zea Mays, L. "Indian Corn." Gramineæ. Constituents: Maizenic acid, tannin, resin, fixed oil and sugar.

Uses.—As Infusion or Decoction and **Fluidextract,** made by the same process as Fl. Extract of Triticum.

Digitalis.—Digitalis, U. S.—Foxglove. Leaves of Digitalis purpurea, L. Scrophulariaceæ, from plants of second year's growth. Constituents: Digitalin, digitoxin and resin. Off. Prep.: Extractum Digitalis; Fluidextractum Digitalis; Infusum Digitalis; Tinctura Digitalis.

The so-called "Digitalin" of commerce is a mixture of the various active principles, and should not be confounded with the pure active principle, **Digitalinum,** which possesses much greater strength. No single principle, however, represents the **entire** therapeutic value of the drug.

Dose.—0.065 Gm. (1 grain).

Ergot.—Ergota, U. S.—Ergot of Rye. Sclerotium of Claviceps purpurea, Tulasne. A fungus replacing the grain of common Rye, Secale cereale, L. Constituents: Cornutin, Sphacelinic acid, Sclerotic acid, fixed oil, etc. Off. Prep.: Extractum Ergotæ; Fluidextractum Ergotæ; Vinum Ergotæ.

Ergot should be kept in a close vessel and protected against insects by a little chloroform; when over one year old it should be rejected.

Some doubt yet exists as to what the medicinally valuable principles of Ergot really are. The fact is conceded, however, that whether they be glucosidal, alkaloidal, or both, or whether it owes its value to a peculiar acid, the desirable principles are more soluble in water than in alcohol, and that, therefore, preparations made with **aqueous** menstrua are preferable to those with **alcoholic** menstrua.

Ergot contains from twenty-five to thirty-five per cent of a non-drying fixed oil more soluble in strongly alcoholic menstrua than in those more aqueous; and since this oil is very undesirable, its presence in the preparations is best avoided through the use of weak alochol as a menstruum.

Dose.—2 Gm.

Uses.—"Ergotin," a misnomer for extracts supposed to represent the medicinal value of the drug. They vary in composition according to the process employed in their preparation, and may contain the principles soluble in alcohol only (Wigger's); those soluble in weaker alcohol (Bonjean's); or those soluble in twenty per cent alcohol, the fixed oil having been removed.

The official Extract, which represents about **eight** times its weight of the drug, is a more reliable preparation than the two first mentioned.

Euonymus.—Euonymus, U. S.—Wahoo. Bark of the Root of Euonymus atropurpureus, Jacquin. Celastraceæ. Constituents:

Eunonymin, resin, asparagus, etc. Off. Prep.: Extractum Eunonymi.

Uses.—**Euonymin,** a resinoid prepared by precipitating the alcoholic tincture in water, is unreliable; the Extract may be substituted for it with advantage.

Dose.—0.5 Gm.

Eupatorium.—Eupatorium, U. S.—Boneset. Leaves and flowering tops of Eupatorium perfoliatum, L. Compositæ. Constituents: Eupatorin, volatile oil, resin. Off. Prep.: Fluidextractum Eupatorii; and Infusion unofficial.

Frangula.—(See Group 5.)

Guarana.—(See Group 8.)

Glycyrrhiza.—Glycyrrhiza, U. S.—Licorice Root. Root of Glycyrrhiza glabra, L., and of the variety glandulifera (Russian). Leguminosæ. Constituents: Glycyrrhizin, glycyramarin, sugar, asparagin and resin. Off. Prep.: Fluidextractum Glycyrrhizæ; Extractum Glycyrrhizæ Purum; Glycyrrhizinum Ammoniatum, Pulvis Glycyrrhizæ comp.; Mistura Glycyrrhizæ comp.; Fluidextractum Sarsaparillæ comp.; Syrupus Sarsaparillæ comp.; Elixir Adjuvans.

Uses.—The pure Extract, prepared by exhausting the root with ammoniated water and evaporating to the consistence of a soft extract, is entirely soluble in water, and therefore superior to the commercial extract of licorice, in the preparation of **Brown Mixture** (Mistura Glycyrrhizæ comp.). It should be mixed with five per cent of Glycerin to preserve it. A **Syrup** and **Elixir** are also prepared from it. (See National Formulary.)

Glycyrrhizinum Ammoniatum.—U. S.—Glycyrrhizin.—Made by precipitating the Ammoniacal liquid extract from the Root with Sulphuric Acid, dissolving the carefully washed precipitate in Ammonia Water, evaporating by a gentle heat until of syrupy consistence, and finally obtained as **scales,** by spreading upon plates of glass to dry.

Extractum Glycqrrhizæ, U. S.—The commercial extract or stick Licorice. Should contain not less than 60 per cent of matter soluble in water.

Uses.—Licorice, owing to its peculiar sweet taste, is largely employed as **adjuvant** to nauseous mixtures and to **disguise** the taste of bitter medicines, as of Quinine. It is the most effective ingredient in **Compound Elixir Taraxacum**—N. F.

Leptandra.—Leptranda, U. S.—"Culver's Root." Rhizome and rootlets of Veronica Virginica, L. Scrophulariaceæ. Constituents: Leptandrin, resin, saponin, etc. Off. Prep.: Extractum Leptandræ; Fluidextractum Leptandræ.

Uses.—"**Leptandrin,**" a resinoid, prepared by precipitating the Alcoholic Tincture in water and drying the precipitated Resin. The remaining clear liquid is boiled and Sulphuric Acid added until it ceases to produce a precipitate, the precipitate washed, dried, mixed with the Resin previously

obtained, and powdered. This preparation is said to represent all the virtues of Leptandra.

Dose.—1 Gm.

Quillaja.—Quillaja, U. S.—Soap Bark. Bark of Quillaja Saponaria, Molina. Rosaceæ. Constituent: Saponin, a poisonous principle. Off. Prep.: Tinctura Quillajæ.

Uses.—As a **Detergent** in cleaning delicate fabrics. Sometimes used to impart the quality of **frothing** to Soda Water Syrups and also as an **Emulsifying Agent,** but its use for these purposes is of questionable advantage.

Quassia.—Quassia, U. S.—Wood of Picrasma excelsa, Planchon (Jamaica) and Quassia amara, L. (Surinam) Simarubaceæ. Constituents: Quassin, resin. Off. Prep.: Extractum Quassiæ; Fluidextractum Quassiæ; Tinctura Quassiæ.

Uses.—As an ingredient in Bitters, and as an Infusion.

Dose.—1 Gm.

Phytolacca.—(See Group 4.)

THE ANTHRAQUINONE GROUP.

Several Drugs owe their therapeutic value to certain principles chemically classed with the **Anthraquinones.**

These principles exist, or are formed, in various combinations, such as **oxymethyl anthraquinone** and its **di** and **tri** modifications.

Many of the constituents attributed to these Drugs, particularly Rhamnus, Rheum and Senna, and also Aloe, are now referred to these compounds, probably decomposition products of glucosides or acids which are **split** by **Ferments** when the Drugs are mixed with water.

They are sparingly soluble in water, but dissolve readily in alkalies with a **deep-red color.**

Alkalies are therefore sometimes used in their **extraction.**

Rhubarb.—Rheum, U. S.—Root of Rheum officinale, Baillon, and Rheum palmatum, L. Polygonaceæ. Constituents: Chrysophan, chrysophanic acid, erythroretin, emodin, phæoretin, aporetin, tannin. Off. Prep.: Extractum Rhei; Fluidextractum Rhei; Pilulæ Rhei; Pilulæ Rhei compositæ; Pulvis Rhei compositus; Syrupus Rhei; Tinctura Rhei; Tinctura Rhei Aromatica.

Uses.—In the **powdered** form obtained from choice specimens of the root. When Rhubarb in small square pieces is heated to about 120°C. (roasted), the principles upon which its cathartic action depends are modified or destroyed, so that it becomes astringent in its properties, "**Torrefied Rhubarb.**"

Senna.—Senna, U. S.—Leaflets of Cassia acutifolia, Delile (Alexandria) and C. Angustifolia, Vahl. (Indian). Leguminosæ. Constituents: Cathartic acid, sennacrol (a bitter principle), sennit. Off. Prep.: Confectio Sennæ; Fluidextractum Sennæ; Infusum Sennæ comp.; Pulvis Glycyrrhizæ comp.; Syrupus Sarsaparillæ comp.; Syrupus Sennæ.

Alexandria Senna is probably more active than the India Sennas but in-

ferior in appearance. The **Tinnevelly** is usually preferred.

Uses.—By extracting Senna with alcohol the principles to which the **griping qualities** are due are removed, without impairing its cathartic properties, when the drug, after being dried, is exhausted with water or weak alcohol.

Dose.—4 Gm.

Santonica.—Santonica, U. S.—Levant Wormseed. Unexpanded flower heads of Artemisia pauciflora, Weber. Compositæ. Constituents: Santonin one and a half to 2 per cent, volatile oil 1 per cent.

Uses.—Wormseed, covered with sugar; and in **Decoction** or **Infusion**, as anthelmintic. The principal use of the drug is in the preparation of Santonin, which in the form of **Troches** is more eligible and effective.

Sarsaparilla.—Sarsaparilla, U. S.—Root of Smilax officinalis. Kunth; S. medica, Schlechtendal and Chamisso; S. papyracea, Duhamel and other species of Smilax. Liliaceæ. Constituents: Parillin, resin, etc. Off. Prep.: Fluidextractum Sarsaparillæ; Fluidext. Sarsaparillæ comp.; Syrupus Sarsaparillæ comp.

Four kinds of Sarsaparilla occur in commerce, viz.: Honduras, Rio Negro, Mexican and Jamaica. Of these, the **Honduras** variety is regarded as superior. It is quite likely that Sarsaparilla, no matter what kind, possesses but little medicinal value, and is an ingredient of only secodnary importance in many of the preparations that bear its name.

Dose.—2 Gm.

Senega.—Senega, U. S.—Root of Polygala Senega, L. Polygalaceæ. Constituents: Senegin, polygalin, or polygalic acid, fixed oil. Off. Prep.: Fluidextractum Senegæ; Syrupus Scillæ comp.; Syrupus Senegæ.

Senega is an exceedingly active drug, and care should be used in dispensing it. Its quality of frothing in aqueous mixtures is owing to the **polygalin**, a substance similar to **saponin.**

Dose.—1 Gm.

Uses.—Infusion and as Extract, formerly official, or Abstract.

Squill.—Scilla, U. S.—Bulb of Uurginea maritima, Baker. Liliaceæ, deprived of its outer scale, sliced and the central portion rejected. Constituents: Scillipicrin, scillitoxin, scillin and mucilage. Off. Prep.: Acetum Scillæ; Syrupus Scillæ; Fluidextractum Scillæ; Syrupus Scillæ comp.; Tinctura Scillæ.

Uses.—In the powdered form; obtained by drying the squill until crisp, and adding about ten per cent of **Milk Sugar** during the process of powdering to preserve the squills in a pulverulent condition.

Dose.—0.125 Gm. (2 grains).

Strophanthus.—Strophanthus, U. S.—The Seed of Strophanthus Kombé, Oliver, Apocynaceæ. Constituents: Strophanthin and fixed oil. Off. Prep.: Tinctura Strophanthi, 10 per cent.

Uses.—As a substitute for Digitalis, as a diuretic.

Dose.—0.065 Gm. (1 grain).

Taraxacum.—Taraxacum, U. S.—Dandelion. Root of Taraxacum officinale, Weber. Compositæ, gathered in autumn. Constituents: Inulin, taraxacin, resin, sugar, etc. Off. Prep.: Extractum Taraxaci; Fluidextractum Taraxaci.

Uses.—In various unofficial preparations; the Extract as excipient for Pills.

Uva Ursi.—Uva Ursi, U. S.—Bearberry. Leaves of Arctostaphylos Uva Ursi, Sprengel. Ericaceæ. Constituents: Tannin, arbutin, ericolin and urson. Off. Prep.: Extractum Uvæ Ursi; Fluidextractum Uvæ Ursi.

Uses.—In Decoction and Infusion, and associated with other diuretic medicines.

Dose.—2 Gm.

Vanilla.—(See Group 4.)

Viburnum Opulus, U. S.—Cramp Bark, and

Viburnum Prunifolium, U. S.—Black Haw, Bark of the Root. Constituents: Bitter principle (viburnin), bitter resin, valerianic acid, tannin. Off. Prep.: Fluidextractum Viburni Prunifolii; Fluidextractum Viburni Opuli.

Uses.—Similar to those of Valerian, which it closely resembles. Viburnum opulus or "Cramp Bark" is frequently preferred to V. prunifolium, because supposed to be more active.

UNOFFICIAL GLUCOSIDAL DRUGS—GROUP SEVEN.

Com. Name.	Bot. Name.	Part Used.	Constituents.
Araroba.	Andira A.	Powder.	Chrysarobin.
Agaric (white).	Boletus laricis.	Plant.	Laricin, resin, acids.
Ailanthus.	A. glandulosa.	Bark.	Ailanthic acid, tannin.
Apocynum (Dog's bane).	A. Androsæmifolium.	R'zome.	Bitter prin., vol. oil.
Bryonia.	B. alba.	Root.	Bryonin.
Carduus Benedictus.	Cnicus benedictus.	Herb.	Cnicin, tannin, etc.
Chamælirium. (False Unicorn).	C. luteum.	R'zome.	Chamælirin.
Cornus (Dogwood).	C. Florida.	Rt. Bk.	Cornin, tan., resin.
Corydalis (Turkey Corn).	Dicentra Canadensis.	Tubers.	Corydalin, resin, fumaric acid.
Coto.	(Source unknown.)	Bark.	Cotoin, vol. oil, acid.
Dulcamara.	Solanum d.	Twigs.	Dulcamarin.
Epigæa (Gravel plant)	E. repens.	Herb.	Arbutin, ericolin, urson, tannin.
Helenium. (Sneezeweed).	H. autumnale.	Herb.	Glucoside, resin, tan.
Helleborus (Black).	Helleborus niger.	R'zome.	Helleborin, helleborein, resin.
Hippocastanum. (Horsechestnut).	Æsculus hippocastaneum.	Bark.	Æsculin, fraxin, tan.
Imperatoria.	I. Ostruthia.	Root.	Imperatorin, vol. oil.
Juglans.	J. Cinerea.	Bark.	Nucin, fix. oil.
Kalmia.	K. latifolia.	Leaves.	Arbutin, resin, tan.
Lactuca (Lettuce).	L. virosa.	Herb.	Lactucin, acid, lactucopicrin.
Larch.	L. Americana.	Bark.	Acid, resin, tan., vol. oil.
Liriodendron.	L. tulipifera.	Bark.	Liriodendrin, resin, tan.
Pansy.	Viola tricolor.	Herb.	Bitter prin., resin.
Piscidia.	P. erythrina.	Bark.	Piscidin, resin, fix. oil.
Polygonatum.	P. biflorum; gigant.	R'zome.	Convall'in, aspa'gin, etc.
Rhus.	R. Toxicodendron.	Herb.	Volatile principl.
Saponaria.	S. officinalis.	Root.	Saponin.
Salix (Willow).	S. alba and spec.	Bark.	Salicin, tannin.
Simaruba.	S. officinalis.	Bark.	Quassin, resin, vol. oil.
Tonka.	Dipterix odorata.	Fruit.	Coumarin, fixed oil.
Ustilago (Corn smut).	U. Maydis.	Fung.	Acids, fixed oil.
Xanthium.	X. spinosum; strumarium.	Fruit.	Xanthostrumarin, resin.

QUESTIONS ON LECTURE VIII, SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink**, writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all the rules of the "Important Notice" must be complied with.

THE DIRECTOR.

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1. To what class of compounds do the **Fixed Oils** belong? (b) Why are they called **Fixed Oils?**
2. How are vegetable and animal **Fixed Oils** respectively **obtained?**
3. Name the **three chief constituents** of Fixed oils.
4. Give the principal **Characteristics** of Fixed oils.
5. What is the chief constituent of Suet?
6. How may **Cotton seed oil** be detected as an adulterant in **Olive Oil?**
7. How are the Liquid fats **classified?** (b) Give an Example of each class.
8. Name preparations into which Oleum Lini enters. (b) What is **Carron Oil?**
9. **When** Flaxseed oil is prescribed, is "Raw" or "Boiled" oil **wanted?** (b) What is "**Sweet Oil**"?
10. What is the difference between Oleum Amygdale Expressum and Oil of Bitter Almonds?
11. Give the **Latin Title** for **Lard Oil**. (b) How is it obtained?
12. Give the **chemical test** for distinguishing between **Drying** and **Nondrying** oils.
13. What **Fish Oil** is official? (b) Name **official preparations** (c) What percent of the oil in the preparations?
14. How do **Castor** and **Croton** oil differ from the other fixed oils? (b) Give their Latin titles and dose of each.
15. What **two** Fatty Substances does the Sheep yield?
16. Why is Lanolin **not** a fat?

17. Name the **official Waxes.** (b) What class of preparations do they enter into?

18. Give Latin title for White Wax. (b) How is it prepared?

19. What is yielded when a solution of a "**Caustic Alkali**" is mixed with a **Fixed Oil?**

20. Name the official **Hard** Soap and **Soft** Soap. (b) From what substances is **each** made? (c) Give other names for the soft soap.

21. What are the **official Fat Acids?**

22. How are the **unofficial** Oleates made?

23. Define the Official Oleates. (b) Name them and give **percentage strength** of each.

24. To what class of chemical compounds does Glycerin belong? Give strength and specific gravity.

25. How do the **Volatile oils** differ from the **Fixed oils?**

26. Name the Classes into which the Volatile oils are divided and give an Example of each.

27. What is the **source** of Oil of Turpentine? (b) What is the **residue** in producing it?

28. Name the Official Nitrogenated oil. (b) Its official preparations.

29. To what **class** of oils does Allyl iso-thiocyanate belong? (b) Upon what does its production depend?

30. What is Camphor? (b) What is the strength of Spiritus Camphoræ?

31. What is the **source** of Thymol? (b) To what class compounds does it belong?

32. What liquid principle obtained from volatile oil of Bitter Almond?

33. What percent of Iodine in Thymol Iodide? (b) What is its **use?**

34. By what **methods** are Volatile oils obtained?

QUESTIONS ON LECTURE IX, SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink,** writing only on one side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞ In order to insure prompt attention, all the rules of the "Important Notice" must be complied with.

The Director.

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1. What is an **Oleoresin** and how does it differ from a **Resin?**
2. Name the **two classes** of Oleoresins and one example from each Class.
3. What is Turpentine?
4. What **two** products are obtained by distilling Turpentine? (b) What **two** from Copaiba?
5. What adulterations are liable to be found in Copaiba and how may they be detected?
6. Name the **three** classes of Resins.
7. Name the two **Natural** Resins.
8. Name the best solvent for Resins. (b) What preparations of Guaiac are official?
9. How does a **Gum-resin** differ from an oleoresin or resin. (b) How are the Gum-resins classified?
10. Name the **official** Gum-resins. (b) When a Gum-resin is triturated with water, what is preparation called?
11. What **Resin** is prepared from an official Gum-resin?
12. Give the official definition of **Elastica.** (b) What is its chief use in pharmacy?
13. How do **Balsams** differ from Resins, oleoresins and Gum-resins?
14. Why is Copaiba not a Balsam?
15. Mention the official Balsams?
16. From what and how is **Benzoic** acid obtained?
17. What **official preparation** made from Hamamelis Bark?
18. How and from **what** is official Tannic Acid prepared?

19. Mention the substances with which Tannic Acid is **incompatible.**

20. What Acid is prepared from Tannic Acid, and how?

21. Mention the official Preparations of Tannic Acid.

22. What is the best solvent for **Gallic Acid.**

23. What is Pyrogallol, chemically; from what, and how made?

24. Define a **Glucoside.**

25. What astringent drug has **replaced** Catechu? And what are its official preparations?

26. How do **Neutral Principles** differ from Glucosides?

27. Name two Glucosides.

28. What addition does the Menstruum for extracting Ergot contain? For Glycyrrhiza?

29. Mention the **official** Reactionary Drugs.

30. Why is Wild Cherry macerated with Water **before** being extracted?

31. What is Allyl iso-thiocyanate, and **how** is it produced?

32. Does Oil of Bitter Almond **exist** in Almonds, already formed?

33. What are the **so-called Resinoids?** Do they always represent the activity of the Drugs from which they are prepared?

34. Define Rheum, U. S. Ph., and name its official preparations.

THE ALKALOIDS.

The Alkaloids are peculiar organic **bases** containing Nitrogen, in addition to Carbon, Hydrogen, and, with few **exceptions**, Oxygen. They are allied to Ammonia, and, when heated with alkalies, give off ammonia, by which they are **distinguished** from the glucosides and neutral principles. They form crystallizable **salts** with acids, and are, medicinally, the most **powerful** of all the organic principles.

The alkaloids are usually named after the **genus** name of the plant from which they are obtained, with the suffix of **ine** (Latin, ina), thus distinguishing them from the neutral principles and glucosides, which terminate in **in** (Latin, inum).

There are many exceptions, however, to this rule, as, for example: Morphine, named in honor of the god of sleep, **Morpheus**; when two or more alkaloids are obtained from the same plant, as in the alkaloids derived from the Cinchonas; when the same alkaloid occurs in several different plants, as Berberine, and when the name of the plant whence the alkaloid is derived has been changed, as Sparteine.

Origin.—The alkaloids may be found in all parts of the plant, yet in the greater number they are contained in the seeds and leaves, and in the trees they occur in the bark. They are usually combined in the plant with one or more organic Acids, often peculiar to the plant, as **meconic acid** in Opium frequently also with some derivative of tannic acid as **kinic** or **kinovic acid** in Cinchona.

Properties.—They are crystalline **solids** with a few exceptions, viz.: Coniine, Lobeline, Sparteine and Nicotine which are **liquid**, and do not contain oxygen, but these also form crystallizable salts with acids. They are all **precipitated** by the **alkalies.**

In **solubility** the alkaloids vary greatly; by far the greater portion are soluble, or only **sparingly** soluble in Water. They are **freely** soluble in Alcohol, especially when hot; some also in Ether, Benzene, Carbon disulphide, and Ethereal Oils, others in Amylic Alcohol and with rare exceptions they are **very soluble** in Chloroform. These liquids are variously used in their extraction, according to their solvent power. Their **Salts** on the other hand are **soluble** in water, some very **freely** so, also in alcohol, but most of them are **insoluble** in ether and chloroform.

Preparation.

The preparation of alkaloids consists usually in extracting the drug with Water acidulated with Hydrochloric or Sulphuric Acids; with others more soluble the organic acids are employed,

while with some, such as Morphine, the drug is exhausted with Water alone. From the watery solution the Morphine is precipitated by an Alkali, such as caustic Lime or Ammonia, which neutralizes the meconic acid with which it is combined as mecon thus liberating the morphine. The morphine is then obta quite pure by solution in boiling alcohol, filtration and crystallization.

The **Cinchona Alkaloids** are best extracted with water, acidulated Hydrochloric Acid, with which the alkaloids form soluble salts. The alkaloids are set free by a strong alkali; Calcium Hydrate (milk of lime) excess, a portion neutralizing the acid, the remainder precipitating alkaloids. From the dried precipitate, the alkaloids are obtained in solution by extraction with alcohol which leaves the alkaloids on evaporation.

To produce salts, sulphates for example, the solution is rendered perceptibly acid to litmus by the addition of dilute sulphuric acid, allowed to crystallize. The separation of the different alkaloids is effect either by fractional crystallization or by the use of different solvents.

With some drugs water extracts so much inert matter, starch, etc., as to interfere with the subsequent extraction of the alkaloids; these are extracted with alcohol which however extracts also inert matter such as resin, etc. Such alcoholic extract is exhausted by repeated shaking out with acidulated water and from this solution the alkaloid is precipitated by an alkali and obtained as a pure base or as a salt by solution in an appropriate dilute acid and crystallized. With the alkaloids of some drugs impaired by this method, the alkaloid is obtained from acidulated solution by neutralizing it and shaking it out repeatedly with chloroform, which leaves the alkaloid upon evaporation.

General Tests.

With chemical reagents the alkaloids behave similarly to **ammonia**; they are all precipitated by **tannic acid**, which, forming an insoluble compound, is given as an **antidote** in cases of poisoning. The reactions vary considerably, and are often characterized by the **coloration** produced, but the following are general tests:

1. **Sulphuric** or **Nitric acid** imparts to many a reddish color.
2. **Phospho-molybdic acid** produces a yellow precipitate.
3. **Sodium phospho-tungstate** forms precipitates, insoluble in water, alcohol, ether, and in all the mineral acids, except phosphoric.
4. **Mercuric Potassium Iodide, U. S.**—Mayer's Solution, forms insoluble precipitates of a yellowish color in acidulated aqueous solution (not alcoholic).
5. With **Platinic** and **Auric Chlorides**, the Alkaloid Chlorides form very insoluble, crystalline double salts similar in composition to the ammonium compounds with the chlorides of these metals.
6. Also with the **Chlorides** and **Iodides** of Mercury, Bismuth, Zinc and Cadmium the Alkaloids unite to form insoluble double compounds.

The Alkaloids and their salts may therefore be regarded as **incompatible** with these substances and they should not be compounded with them.

THE ALKALOIDAL DRUGS.

The Cinchona Barks.

The Cinchona Barks are obtained from different species of the genus Cinchona, and vary considerably in the proportion of alkaloids they contain, hence also in medicinal value.

Formerly Cinchona was derived exclusively from South America where it was indigenous to Bolivia and Peru (Peruvian Bark). During recent years Cinchona trees have been cultivated in the East Indies, notably in the Dutch possessions of Ceylon and Java, which produce barks yielding a far greater proportion of alkaloids than obtained from American Cinchonas and also in increasing the relative amount of the most valuable alkaloid, the Quinine.

The **assay** process consists in extracting the Cinchona with a mixture of Chloroform, Ether and Ammonia water and converting the alkaloids into sulphates, by shaking with diluted Sulphuric Acid.

From the aqueous solution the alkaloids are extracted by shaking with a mixture of Chloroform and Ether, containing sufficient Ammonia Water to neutralize the acid, which leaves the pure anhydrous Alkaloids upon evaporation. By shaking the aqueous solution with Ether and Ammonia Water only the Ether-soluble alkaloids are obtained and on these which comprise the **quinine, quinidine** and **cinchonidine**, but not the Cinchonine, depends the value of the bark.

Cinchona—Cinchona, U. S.—Calisaya Bark. Bark of Cinchona Ledgeriana, Moens; Cinchona Calisaya, Weddell; C. officinalis, L., or their hybrids, Rubiaceæ. Constituents: Kinic, kinovic and cinchotannic acids; quinine, quinidine, cinchonine, cinchonidine and quinamine.. Off. Prep.: Extractum Cinchonæ; Fluidextractum Cinchonæ; Tinctura Cinchonæ.

While the U. S. Ph. directs that this bark should contain at least four per cent of quinine, good specimens contain as much as 8 or 10 per cent of it, and correspondingly less of the other inferior alkaloids. Calisaya is also the most desirable kind of the cinchonas pharmaceutically, because it contains less of the more or less inert and insoluble constituents, such as cinchonic red, etc., and the liquid preparations are therefore less liable to precipitate than those made from other kinds of bark.

Red Cinchona—Cinchona Rubra, U. S.—Bark of Cinchona succirubra, Pavon, or hybrids, Rubiaceæ, containing not less than five per cent of anhydrous alkaloids. Constituents: Same as C. Calisaya. Off. Prep.: Tinctura Cinchonæ composita.

This Cinchona, also known as Red Peruvian Bark or simply "Red Bark," contains somewhat less quinine than the Calisaya, and a larger proportion of the other constituents, especially cinchonic red. It is a valuable tonic, and for this reason is directed to be used in the Compound Tincture of Cinchona. Its liquid preparations, especially the Fluid Extract (unofficial), are exceedingly prone to precipitate, which is to a great extent avoided by the addition of glycerin to the menstrua, which serves to keep the cinchonic red in solution.

Extractum Chinæ aquosum, Ph. Ger. "Ext. Chinæ frigid. parat.," an extract prepared by exhausting the coarsely powdered bark with successive portions of water, concentrating, filtering and evaporating to soft extract consistence.

Spurious, or false, barks are distinguished from the Cinchona barks by Grahe's test: When about 1 Gm. of the bark, in pieces, is heated in a test-tube, carmine-red vapors are given off which finally condense to a red colored, tarry liquid, if true Cinchona bark.

The Cinchona Alkaloids.

A great many alkaloids have been obtained from Cinchona but most of these are derivatives of one of the four principal ones. These may be divided into two groups according to their characteristics:

1. Quinine and Quinidine.
2. Cinchonine and Cinchonidine.

Cinchona Alkaloids and Salts.	Formula.	Solubilities - 25° C.			
		Water	Alcoh'l	Ether	Chloform
QUININA (Quinine)......	$C_{20}H_{24}N_2O_2 + 3H_2O$.........	1750	0.6	4.5	1.9
Quininæ Sulphas........	$(C_{20}H_{24}N_2O_2)_2\ H_2SO_4 + 7H_2O$	720	86	insol,	400
Quininæ Bisulphas........	$C_{20}H_{24}N_2O_2\ H_2SO_4 + 7H_2O$..	8 5	18	1770	920
Quininæ Hydrochloridum...	$C_{20}H_{24}N_2O_2\ HCl + 2H_2O$.....	18	0.6	240	0 8
Quininæ Hydrobromidum...	$C_{20}H_{24}N_2O_2\ HBr + H_2O$....	40	7	16	very
Quininæ Salicylas..........	$C_{20}H_{24}N_2O_2\ C_7H_6O_3 + H_2O$....	77	11	110	37
Cinchoninæ Sulphas........	$C_{19}H_{22}N_2O)_2H_2SO_4 + H_2O$....	18	10	2300	69
CINCHONIDINÆ Sulphas..	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 3H_2O$..	63	72	4400	900

In solubilities they differ widely, especially as to their solubility in Water, the Quinine Hydrochlorate being very soluble, the **acid** Sulphate the most soluble of all, the **neutral** Sulphate the least soluble. The bases and all their salts are fairly soluble in **alcohol,** Cinchonine the least of any. In **ether,** Quinine is moderately soluble, its Salts, except the Hydrobromide, almost insoluble; the other three bases and their salts are very sparingly soluble in **ether,** the Cinchonine least of all, and upon this is based the method of separating the Quinine from the other alkaloids, in the process for assay.

Quinine and Quinidine form two series of salts, viz.: **Neutral** salts as the Sulphate and **acid** salts as the Bisulphate; the former being very sparingly soluble in Water; the latter much more soluble.

While the solubility of the Quinine base in Water is increased by Ammonia and decreased by Potassa and Soda, the base is precipitated from the solutions of its Salts by all these alkalies, as well as by the Alkaline Carbonates and Bicarbonates.

The acid solutions of the Salts of the Quinine Group, Quinine and Quinidine, give a **blue** Color, termed **fluorescence** (1 in 100,000) which is prevented by Chlorine, Bromine, Iodine and Ferrocyanides. They also afford reactions through which they and their salts are more clearly distinguished from the alkaloids of the other group, Cinchonine and Cinchonidine, viz:

Thalleioquin Test.—If to 10 cc of an aqueous solution (1 in 1300) is added 5 drops Bromine T. S. and then Ammonia Water in excess, a beautiful green color is produced.

The second group, Cinchonine and Cinchonidine, do not afford any **fluorescence** in dilute acid solutions; they do not produce the thalleioquin reaction and their free bases crystallize water-free, while the Quinine bases crystallize with water, forming efflorescent hydrates.

The Groups differ in their behavior to Polarized light:

Quinine and Cinchonine are **lævogyrate.**

Quinidine and Cinchonidine are **dextrogyrate.**

The Tartrates of Quinine and Cinchonine are **sparingly** soluble in water.

The Tartrates of Quinidine and Cinchonidine are **easily** soluble in water.

To determine whether or not Quinine or its Salts are **contaminated** with the other alkaloids, advantage is taken of the **solubility** of Quinine Sulphate in Ammonia Water, as compared with the **insolubility** of the other Alkoloidal Sulphates, the method employed being a modification of **Kerner's Test** and is prescribed for Quinine and its most important Salts.

Quinine sulphate, with 7 molecules of water of crystallization, contains 16.18 per cent of Water and upon exposure loses as much as 10 to 12 per cent of its weight; it should be kept therefore in tightly stoppered containers in not too dry a place.

Uses.—Chiefly in the form of powder inclosed in capsules, cachets and pills, coated with sugar or gelatin. The capsules should be given the preference over coated pills and have the advantage of being prepared in the pharmacy. For pill mass the best **excipient** is Glucose or Glycerite of Starch. Dilute or Aromatic Sulphuric Acid acts dissolving upon the salt and forms a mass which however becomes friable and must be quickly formed into pills.

Average Dose.—All the Alkaloids and their Salts 0.25 Gm. (4 grains).

OPIUM.

Opium—Opium, U. S.—Concrete, milky exudation obtained by incising the unripe capsules of Papaver somniferum, L., Papaveraceæ, yielding in its normal moist condition not less than nine per cent of crystallized Morphine. Constituents: Morphine, codeine, thebaine, narcotine, narceine, pseudomorphine, papaverine, and

many other alkaloids; also meconic acid, thebolactic acid and meconin. Off. Prep.: Opii Pulvis; Opium Granulatum.

Opium contains about ten per cent of moisture, in exceptional instances twenty or even thirty per cent, and from nine to fourteen per cent of morphine. Preparations of opium should therefore not be prepared from the crude drug, but from the Granulated, or powdered opium, which are of more constant strength.

The **process of assay** consists in exhausting the Opium with water and precipitating the alkaloids with Ammonia Water; the crystals are carefully separated from the mother-liquid and washed with Ether and Alcohol until obtained in a pure state.

The processes for the assay of the Tincture and the Extract differ in no essential particular from the process applied to the crude opium.

Powdered Opium.—Opii Pulvis, U. S.—Powdered Opium containing not less than 12 nor more than 12.5 per cent of crystallized morphine.

Prepared by drying the crude drug, first separated into smaller pieces, at a temperature not exceeding 85°C. (185°F.), until it ceases to lose weight, and then reduced to a very fine (No. 80) powder. It is then assayed for its morphine strength and, if necessary, mixed with other specimens of powdered opium, to bring the strength within the limits prescribed by the Pharmacopœia.

Dose.—0.065 Gm. (1 grain).

Granulated Opium—Opium Granulatum, U. S.—Opium dried and reduced to a number 20 powder—same Morphine strength as the Powder.

This form of Opium is better adapted for extraction than the finer powder.

Average Dose.—0.10 Gm. (1½ grains).

Deodorized Opium—Opium Deodoratum, U. S.—Opium Denarcotisatum—U. S. '80.

Prepared from powdered opium by exhausting it with Purified Petroleum-Benzin, which extracts the principles to which opium is supposed to owe its disturbing qualities. The opium is freed from the Benzin by exposure to air. It is of the same morphine strength as the powdered opium.

This is essentially the process employed in the preparation of the Deodorized Tincture of Opium. Petroleum benzin has been substituted for ether, owing to its economy; it does not extract narcotine but it removes the objectionable principles.

Average Dose.—0.10 Gm. (1½ grains).

Opium or its preparations may be recognized by the **deep-red** coloration produced by one if its constituents, Meconic Acid, with Ferric Salts, which differs from that produced with acetic acid by not disappearing on the addition of dilute hydrochloric acid.

The following preparations of opium are official:

Acetum Opii, Vinum Opii;

Tincturæ: Opii; Opii Deodorata; Ipecacuanhæ et Opii; and

Pulvis Ipecacuanhæ et Opii; all 10 per cent opium,

Extractum Opii, with Sugar of Milk to 20 per cent Morphine, Emplastrum Opii (6 per cent Ext.).

Tinctura Opii Camphorata 0.4 per cent.

Pilulæ Opii 6.5 cg. (ea.); Trochisci Glycyrrhizæ et Opii (5 mg.).

The Opium Alkaloids.

Of the nineteen alkaloids obtained from Opium, only two are official, viz.: Morphine and Codeine; a third, Apomorphine, being produced artificially from either of these.

Morphine, the first alkaloid discovered, crystallizes with one molecule of water, $C_{17}H_{19}NO_3+H_2O$.

It is very sparingly soluble in Water, Ether or Alcohol except at the boiling temperature. The salts are freely soluble in Water and, except the sulphate, also moderately soluble in Alcohol; they are all practically insoluble in Ether.

The alkaloid and its salts are precipitated by solutions of Potassa and of Soda, but the precipitate is dissolved in excess of the alkali, in which Morphine differs from other alkaloids. It forms a bright **red** color with Nitric Acid, but remains colorless or becomes only slightly yellowish with Sulphuric Acid, if free from the other opium alkaloids (narcotine, papaverine, etc.), and upon the addition of a small crystal of Potassium Permanganate, it should acquire but a greenish, no violet or purple color (distinction from strychnine). The 1-per cent solution of the sulphate produces a **blue** color with a few drops of solution of Ferric Chloride, which is destroyed by acids, alcohol, or by heating. Morphine solution is rendered cloudy by Tannic Acid but the whitish coloration (or precipitate) quickly disappears upon the addition of Acetic Acid.

Morphine is a powerful reducing agent, acting upon oxides and salts of Silver and Gold and acids of Iodine, liberating the Iodine, thus producing a **reddish** color in Hydriodic Acid; it acts similarly upon the acids of Titan, Wolfram, Tin and Vanadium and with:

Froehde's Reagent (a 1-per-cent solution of Sodium Molybdate in Sulphuric Acid) it produces a play of colors ranging from **violet** into **blue,** then from dirty **green** into **yellow** and finally into pale **red** or pink. This is the most sensitive test for morphine, the reaction occurring with 1-200 mg. of the alkaloid in most dilute solution.

Sulphuric acid, containing in each cc. 1 drop Formaldehyde Solution, yields an intense purple color.

By boiling with Acids and treating it with Alkalies, Morphine loses one molecule of water and becomes **Apomorphine,** $C_{17}H_{17}NO_2$, the Hydrochloride of which is official; it has entirely different properties from morphine and is more powerful as a **poison.**

Codeine is separated from morphine by precipitation and solution in Ether in which it is very soluble. Codeine throws morphine out of solution, when added to solutions of morphine salts.

Uses.—Morphine in powder, or granules, containing from ½ cg. (1/12 gr.) to 3 cg. (½ gr.), the maximum dose. **Hypodermically** the dose is one-half as much, or even less. A solution formerly official (70) contained 1 grain to the fl. ounce of water; **Magendie's** solution contained 2 grains to the fl. dram. Great care must be exercised in distinguishing between these two solutions, as fatal consequences have resulted from their confusion. Solutions of morphine should specify the strength desired. It should never be administered to children, the least quantity having sometimes proved fatal.

Opium, Alkaloids and Salts.	Formula.	Solubilities, 25°C.			Dose.	
		Water.	Alcohol	Ether.	Gm.	gr.
MORPHINA (Morphine)	$C_{17}H_{19}NO_3 + H_2O$	3,330	168	4.464	0.01	1-5
Morphinæ Sulphas	$(C_{17}H_{19}NO_3)_2 H_2SO_4 + 5H_2O$	15.3	465	insol.	0.015	¼
Morphinæ Hydrochloridum	$C_{17}H_{19}NO_3\ HCl + 3H_2O$	17.2	42	"	0.015	¼
Morphinæ Acetas	$C_{17}H_{19}NO_3\ C_2H_4O_2 + 3H_2O$	2.25	21.6	"	0.015	¼
Apomorphinæ Hydrochloridun	$C_{17}H_{17}NO_2 HCl$	45	45	....	exp. 0.002	1-30
CODEINA (Codeine)	$C_{18}H_{21}NO_3 + H_2O$	88	1.6	22.5	....	....
Codeinæ Phosphas	$(C_{18}H_{21}NO_3)_3 H_3PO_4 + 2H_2O$	2.25	261	1,340	0.03	½
Codeinæ Sulphas	$(C_{18}H_{21}NO_3)_2 H_2SO_4 + 5H_2O$	30	1,035	insol.	0.03	½

For **antidote** the stomach should be evacuated as promptly as possible by Mustard infusion, Zinc or Copper Sulphate. Hot Decoction of Coffee with Brandy or Whisky, but without milk, and exercise; as physiological antidote, Belladonna, or Atropine, hypodermically, should be employed.

Codeine is used as a substitute for morphine in twice the dose.

Apomorphine is used only as an emetic, dose 1 cg., or subcutaneously in one-half the dose.

NUX VOMICA.

Nux Vomica—Nux Vomica, U. S.—Seed of Strychnos Nux-vomica, L., Loganiaceæ. Constituents: Strychnine not less than 1.25 per cent, brucine, igasuric acid and fixed oil.

Uses.—Chiefly for the preparation of Strychnine, one of the most powerful poisons, used extensively by trappers for killing fur-bearing animals; also in the powdered form. Nux vomica is reduced to a powder only with great difficulty, owing to its flexible or horny character, and to the fact that it contains about five per cent. of fixed oil. By subjecting the seeds to the action of live-steam, however, and subsequently drying them, the integuments become brittle, and they are then easily powderd.

All the preparations of Nux Vomica are required to contain a definite percentage amount of Strychnine.

Following are the official Preparations with their Strychnine strength:

Extractum Nucis Vomicæ, contains 5% Strychnine, 5 times the Fluidextract.

Extractum Nucis Vomicæ Fluidum, contains 1% Strychnine; 10 times the Tincture.

Tincturæ Nucis Vomicæ, contains 0.1% Strychnine; one-fiftieth the extract.

In order to obtain the Extract in the powdered form the drug is extracted with acetic acid which dissolves little if any of the fixed oil, which would be objectionable as if present the oil causes the extract "to cake"; it is then assayed and mixed with Milk Sugar so as to represent 5% Strychnine.

From this Extract the **Tincture** is made by solution in alcohol and water.

The **process of Assay** for Nux Vomica consists in extracting the alkaloids and obtaining them in a pure state by shaking out the neutralized acidulated solution with chloroform, separating the Strychnine from the Brucine and then determining the amount of strychnine by **titrating** the solution of it in tenth-normal sulphuric acid V. S. with fiftieth-normal Potassium Hydroxide V. S., using iodeosin as indicator.

The Strychnos Alkaloids.

The plants of the Strychnos Family furnish several alkaloids distinguished as the most poisonous of the vegetable principles. The most important of these is **Strychnine,** obtained from the seed of Strychnos Nux-vomica and also from other plants of the Loganiaceæ, especially Strychnos Ignatia, formerly official. A second alkaloid, **Brucine,** is obtained as a by-product from the mother-liquid. The most powerful poison, "Curare," used for poisoning arrows by Indians, and an alkaloid, **curarine,** are derived from allied plants.

Strychnine is almost insoluble in Water (6,700), but it is so intensely bitter that one grain is sufficient to impart a decided **bitter taste** to over 10 Gallons of Water; it is slightly soluble in Alcohol, insoluble in Ether, but very soluble in Chloroform, hence the use of this solvent in processes for the extraction of the alkaloids. Its salts, especially the sulphate, are moderately soluble in water and alcohol.

Brucine is much more soluble in Water and very soluble in Alcohol and Chloroform, but insoluble in Ether. It is poisonous but less so than Strychnine.

Strychnine is not colored by Sulphuric Acid, but when a little of it is dissolved in Sulphuric Acid and then a small crystal of Potassium Dichromate is drawn through the liquid with a glass-rod, there will be produced a series of variegated colors, at first **blue** to **purplish-blue,** then gradually to **violet, purplish-red** and **cherry-red** in rapid succession and finally into **orange** or **yellow.** This is the most characteristic test for strychnine.

Strychnine is colored **yellow** by Nitric Acid, whereby it is distinguished from Brucine, which is colored **blood-red** by Nitric Acid and also in a mixture of it and Sulphuric Acid. Boiled with Hydrochloric Acid the liquid turns **red** upon the addition of a trace of Nitric Acid. A solution of Brucine in Nitric Acid is rendered intense violet by Ammonium Sulphydrate.

Uses.—In the form of **trituration, tablets,** granules and associated with other agents in **elixirs,** syrups, etc. **Hall's solution** contains 1 grain of strychnine to the fl. ounce of weak Acetic Acid (colored red). Another solution contains 4 grains to the fl. ounce of Alcohol (preferably alcohol 70%); the best form may be made metrically; 1 Gm. in 100 C.C. which is a saturated solution.

Strychnos Alkaloids and Salts.	Formula.	Solubilities—25° C.			
		Water	Alcoh'l	Ether	Chlor form
STRYCHNINA (Strychnine)	$C_{21}H_{22}N_2O_2$	6400	110	5500	6
Strychninæ Sulphas	$(C_{21}H_{22}N_2O_2)_2H_2SO_4+5H_2O$	31	65	insol.	295
Strychninæ Nitras	$C_{21}H_{22}N_2O_2 \cdot HNO_3$	42	120	"	156

Average Dose.—Strychnine and all its Salts, 0.001 Gm. (1/64 grain).

The **Hypodermic solution** is made from the sulphate, one-per-cent solution in Water (1 Gm. in 100 C.C.).

Antidote.—Prompt evacuation of the stomach by emetics, Mustard Infusion. Physiological antagonists are: Apomorphine hypodermically 2 cg., Chloral and Chloroform; afterward purging with Castor Oil, saline Cathartics.

The Mydriatic Alkaloids.

A number of plants belonging to the Solanaceæ yield a class of alkaloids which exercise a peculiar effect of dilating the pupil of the eye. This effect is termed **mydriasis** and the agents producing it, **mydriatics.**

These alkaloids, of which Atropine is the type, comprise Hyoscyamine, Hyoscine and several others, which, although obtained from different plants, are so closely related as to be considered identical and have nearly the same chemical and physical properties.

Atropine, the most important of this class, is obtained chiefly from the leaves and root of Atropa Belladonna; **Hyoscyamine** is obtained from the leaves and seeds of Hyoscyamus niger and also from the seeds of Datura Stramonium, formerly called **daturine;** from Duboisia myoporoides (**duboisine**) and from the rhizome of Scopolia Carniolica, the alkaloid of which is also called **scopolamine,** and also as a by-product in the preparation of Atropine. Recent researches indicate that these are all identical with Hyo-

scyamine and in fact that the two alkaloids may be obta‹‹ned from any one of all the different plants here mentioned.

Hyoscine is an uncrystallizable alkaloid derived from the mother-liquid from the preparation of Hyoscyamine and Atropine, from which it is also produced, by converting it into a Hydrochloride, precipitating it as a Gold double-chloride, decomposing this and dissolving in Ether and crystallizing it as Hydrochloride.

Mydriatic Alkaloids and Salts.	Formula.	Solubilities, 25°C.			
		Water.	Alcohol	Ether.	Chloroform
ATROPINA (Atropine)	$C_{17}H_{23}NO_3$	430	1.46	16 6	1.56
Atropinæ Sulphas	$(C_{17}H_{23}NO_3)_2\ H_2SO_4$	0.38	3.7	2,140	6 20
HYOSCYAMINÆ, Sulphas.	$(C_{17}H_{23}NO_3)_2\ H_2SO_4$	0.5	6.4	2,500	2,300
Hyoscyaminæ Hydrobromidum	$C_{17}H_{23}NO_3HBr$	0.3	2.	1,600	2.5
HYOSCINÆ Hydrobromidum	$C_{17}H_{21}NO_4HBr + 3H_2O$	1.5	16.	insol.	750
Homatropinæ Hydrobromidum	$C_{16}H_{21}NO_3HBr$	5.7	32.5	insol.	620
Scopolaminæ Hydrobromidum	Identical with Hyoscine				

As to solubilities, the official Salts of these alkaloids are all very **soluble** in Water and in Alcohol; they are all very slightly soluble in Ether and sparingly or very slightly soluble in Chloroform. The base, Atropine, is sparingly soluble in water, but freely soluble in alcohol, ether and chloroform.

Atropine is split by HCl, at 100 to 130°C., into Tropin, $C_8H_{15}NO$ and Tropic Acid, $C_9H_{10}O_3$; the former by reagents is reduced to a number of derivative compounds and by condensation with Mandelic Acid furnishes:

Homatropine Hydrobromide.—$C_{16}H_{21}NO_3$. HBr.—Said to act quickly as atropine and to have the advantage in that the effects on the pupil (dilatation) is of but from 12 to 24 hours duration as against a period of 8 days for the effects of atropine to wear off.

Uses.—In ophthalmology in one-per-cent solution. Hypodermically in doses ranging from ¼ mg. (1-250 gr.) Sometimes by the mouth in doses somewhat larger, in the form of granules, tablets, etc.

Average Dose.—Atropine and its Salts, 0.4 mg. (1-160 grain). Hyoscyamine, Hyoscine, Homatropine, Scopolamine and their Salts, 0.5 mg. (1-128 grain).

These Alkaloids and their Salts all respond to practically the same reactions:

With Sulphuric Acid no coloration until warmed, then **brownish**; 1 mg. warmed with Sulphuric Acid and diluted with an equal volume of Water, develops **orange-flower** odor and by the addition of a crystal of Potassium Dichromate or Permanganate the odor is changed to that of **Bitter Almond.**

A grain of it sprinkled with Nitric Acid and heated to dryness leaves a **yellow** residue, which when dampened with alcoholic Potassium Hydroxide

and a fragment of Potassium Hydroxide added produces an intense violet color (Vitali's test).

All these alkaloids and their salts produce precipiates with Mercuric-potassium Iodide, but not with Platinic Chloride, through which they are distinguished from most other alkaloids.

They all produce precipitates with Auric Chloride and through the appearance of this compound, crystallized from alcohol, the various bases may be distinguished from each other. (See U. S. Ph.)

Other Official Alkaloids.

OFFICIAL ALKALOIDS AND THEIR SALTS.

NAME.	FORMULA.	SOURCE.	SOLUBILITIES, 25°C. Water	Alcohol	Ether	AVERAGE DOSE Gm.	gr.
Aconitina	$C_{34}H_{47}NO_{11}$	Aconitum	3,200	22	44	1-15	1-400
Caffeina	$C_8H_{10}N_4O_2+H_2O$	Thea, etc.	45.6	53.2	375	0.065	1.
Cocaina	$C_{17}H_{21}NO_4$	Coca	609	5	3.8	0.08	½
Cocainæ Hydrochloridum	$C_{17}H_{21}NO_4HCl$	Coca	0.4	2.6	insol.	0.08	½
Colchicina	$C_{22}H_{25}NO_6$	Colchicum	22	very	155	0.5 mg	1-128
Hydrastina	$C_{21}H_{21}NO_6$	Hydrastis	insol.	135	124	0.01	1-5
Hydrastininæ Hydrochloridum	$C_{11}H_{11}NO_2HCl$	Artificial	very	very	1,300	0.08	½
Physostigminæ Sulphas	$(C_{15}H_{21}N_3O_2)_2H_2SO_4$	Physostigma	very	very	1,200	0.001	1-64
Physostigminæ Salicylas	$C_{15}H_{21}N_3O_2C_7H_6O_3$	Physostigma	72.5	12.6	175	0.001	1.64
Pilocarpinæ Hydrochloridun	$C_{11}H_{16}N_2O_2HCl$	Pilocarpus	0.3	2.3	insol.	0.01	1-5
Pilocarpinæ Nitras	$C_{11}H_{16}N_2O_2HNO_3$	Pilocarpus	4	60	insol.	0.01	1-5
Sparteinæ Sulphas	$C_{15}H_{26}N_2H_2SO_4$	Scoparius	1.1	2.4	insol.	0.01	1-5

Aconitine—Aconitina, U. S.—From Aconite—The most poisonous of the Alkaloids.

Should not be confused with "Aconitia," official in U. S. '70, a mixture of principles. The peculiar tingling sensation characteristic of aconite is produced on the tongue by one drop of the most extremely dilute solution 1 in 2,000 or the strength of the tincture.

Uses.—In pills, granules, tablets, etc.

Dose.—0.15 milligram (1-400 grain).

Caffeine—Caffeina, U. S.—Theine. From "Tea," Thea Sinensis, L., Ternstrœmiaceæ; Coffea Arabica, Rubiaceæ; also from Guarana and some other plants.

A very feeble base and forms salts with difficulty. The official preparations of it are not true compounds, but simply mixtures with citric acid.

Caffeina Citrata, U. S.—Caffeine and Citric Acid equal parts, dissolved in water, evaporated to dryness and powdered. It forms a clear solution with 3 parts of water, but is precipitated upon further dilution until 25 parts of water is added when it remains clear.

Caffeina Citrata Effervescens, U. S.—Same as the preceding mixed with Sodium Bicarbonate and Tartaric Acid, made into a paste with Alcohol, rubbed through a coarse sieve, dried and obtained as a granular powder.

It contains 4% of Citrated Caffeine.

Dose.—4 Gm.

Cocaine—Cocaina, U. S.—From Coca. The alkaloid is used chiefly in preparations where the hydrochloride would be incompatible; also in:

Oleatum Cocainæ U. S.—5 per cent.

Cocaine Hydrochloride—Cocainæ Hydrochloridum, U. S.

The hydrochloride is the salt usually employed and is inadvertently dispensed even when the alkaloid itself may be prescribed.

Heated with Sulphuric Acid it gives off vapors of Benzoic Acid; at the ordinary temperature it is not colored by Sulphuric or Nitric Acids. It should be tested for the absence of other Coca bases by potassium permanganate. It may be distinguished by the sense of numbness it leaves upon the tongue.

Uses.—Chiefly in the form of solution from 1 to 5 per cent strength for **hypodermic** use. These should be prepared by metric quantities; 1 Gram for each per cent wanted, in 100 C.C. of Sterile or Chloroform Water. It should **not be dispensed except upon prescriptions.**

Colchicine—Colchicina, U. S.—From Colchicum. Does not form salts readily.

With a little sulphuric acid and Potassium Dichromate it gives a greenish-blue color changing to orange.

Dose.—0. 5 milligram (1-128 grain).

Hydrastine—Hydrastina, U. S.—From Hydrastis. The so-called White Alkaloid; does not readily form Salts.

Uses.—Chiefly in solution as injection.

Dose.—0.01 Gm. (1-5 grain).

Hydrastinine Hydrochloride—Hydrastininæ Hydrochloridum, U. S.—An artificial alkaloid derived from Hydrastine.

Through oxidizing agents Hydrastine $C_{21}H_{21}NO_6$ is converted into Hydrastinine, $C_{11}H_{11}NO_2$ and Opianic Acid, $C_{10}H_{10}O_5$:

$$C_{21}H_{21}NO_6+O=C_{11}H_{11}NO_2+C_{10}H_{10}O_5.$$

The hydrochloride is in light yellow, amorphous granules or a pale yellow crystalline powder. It imparts a blue fluorescence to water, 1 mg. in 100 Liter.

Uses.—As an emmenagogue, as a substitute for Ergot.

Dose.—0.03 Gm. (½ grain).

Pelletierinæ Tannas—U. S.—Tannate of alkaloids obtained from Granatum. Insoluble in liquids.

Uses.—As a **tænicide.** **Dose.**—0.25 Gm. (4 grains).

Physostigmine Sulphate—Physostigminæ Sulphas, U. S.—Eserine Sulphate. From Physostigma, "Calabar Bean."

A yellowish white powder, very deliquescent, gradually turning reddish upon exposure to the air and light and should therefore be kept in small, dark, amber-colored and well-stoppered vials.

Dose.—1 mg. (1-64 grain).

Physostigmine Salicylate—Physostigminæ Salicylas, U. S.—Eserine Salicylate.

Faintly yellowish, acicular crystals, acquiring a reddish tint upon exposure and must therefore be kept with same precautious as the sulphate. Its aqueous solution produces with ferric chloride a deep violet color.

Uses.—As a motor depressant. Also in gelatin disks, Lamellæ, Ph. Br., containing 1-1000 grain.

Dose.—1 mg. (1-64 grain).

Pilocarpine Hydrochloride—Pilocarpinæ Hydrochloridum, U. S.—From Pilocarpus, or Jaborandi.

Small white crystals, deliquescent on exposure to damp air and should therefore be kept in small well-stoppered vials.

Uses.—A motor depressant, diaphoretic and sialagogue.

Dose.—10 mg. (1-6 grain).

Pilocarpine Nitrate—Pilocarpinæ Nitras, U. S.

Uses.—Same as the hydrochloride. Same dose.

Sparteine Sulphate—Sparteinæ Sulphas, U. S.—The neutral Sulphate of an alkaloid obtained from Scoparius, Cytisus (Spartium) Scoparius.

White, prismatic crystals or granular powder, deliquescent when exposed to damp air.

Uses.—A motor excitant, diuretic, laxative, in large doses emetic.

Dose.—10 mg.

Veratrine—Veratrina, U. S.—A mixture of Alkaloids obtained from Cevadilla seed, Asagrea officinalis (not from Veratrum).

To the alkaloids obtained from Sabadilla and Veratrum (White Hellebore), the name was first applied, but when the distinction of the alkaloids of the two drugs had been proved, the name of **veratrine** was retained for the total alkaloids derived from Cevadilla, while those found in Veratrum were termed **jervine, veratralbine,** etc.

With Nitric Acid it forms a **yellow** solution; with Hydrochloric Acid upon heating a **deep-red** color. With Sulphuric Acid, upon trituration in a glass-mortar, it forms a **yellow** or **orange-red** solution, exhibiting by reflected light a **greenish** fluorescence, while **deep-red** by transmitted light.

Uses.—Only externally in the form of the **Oleate** (2%), **Ointment** (4%). It produces great irritation in contact with the nasal membrane and, therefore, should not be triturated in its dry form, but with the addition of a liquid substance. It is very **poisonous.**

Dose.—2 mg. (1-30 grain).

UNOFFICIAL ALKALOIDS.

Name of Alkaloid.	Formula.	Source.	Solubilities*.			Dose.	
			Water	Alco.	Ether.		gr.
Aspidospermine .	$C_{22}H_{30}N_2O_2$ ...	Aspidosp'ma	6000	50	100	dcg. 1	1-2
Berberine hydrochlor ...	$C_{20}H_{17}NO_4$ .... $HCl+4H_2O$.	Berberis, Hydrastis .	Mod.	Mod.		" 1-3	1½-3
Coniine hydrobrom ...	$C_8H_{17}N, HBr$. .	Conium	"	"	Insol.	cg. 1	1-6
Delphinine	$C_{22}H_{35}NO_6$	Staphisagria	Insol.	20	10	......	......
Emetine	Not determin'd	Ipecac	1000	Freely	Freely	cg. 1	1-6
Gelsemine	$C_{12}H_{14}NO_2$	Gelsemium ..	Sp'g'ly	"	"		
Jervine	$C_{26}H_{37}NO_3+2H_2O$	Veratrum .. alb, et vir.	Insol.	Mod.	Spar.	......	......

ALKALOIDAL DRUGS.

The U. S. Ph. VIIIth fixes standards for some eighteen Drugs and most of the preparations of these.

These Standards, fixed by Assay Methods, are as follows:

Preparation.	Principle.	Minimum.
Aconitum	Aconitine	0.5 per cent.
Fluidextractum	Aconitine	0.4 in 100 c.c.
Tinctura	Aconitine	0.045 in 100 c.c.
Belladonnæ folia	Mydriatic alkaloids	0.35 per cent.
Emplastrum	Mydriatic alkaloids	0.38-0.42 per cent.
Extractum	Mydriatic alkaloids	1.4 per cent.
Tinctura	Mydriatic alkaloids	0.035 per cent.
Belladonnæ radix	Mydriatic alkaloids	0.5 per cent.
Fluidextractum	Mydriatic alkaloids	0.5 in 100 c.c.
Cinchona	Alkaloids	4 per cent. ether soluble.
Fluidextractum	Alkaloids anhydrous	4 in 100 c.c.
Coca	Alkaloids ether soluble	0.5 per cent.
Fluidextractum	Alkaloids ether soluble	0.5 per cent.
Colchici cormus	Colchicine	0.5 per cent.
Extractum	Colchicine	1.4 per cent.
Colchici semen	Colchicine	0.55 per cent.
Fluidextractum	Colchicine	0.5 in 100 c.c.
Tinctura	Colchicine	0.05 in 100 c.c.
Conium	Coniine	0.5 per cent.
Fluidextractum	Coniine	0.45 in 100 c.c.
Guarana	Alkaloids	3.5 per cent.
Fluidextractum	Alkaloids	3.5 in 100 c.c.
Hydrastis	Hydrastine	2.5 per cent.
Fluidextractum	Hydrastine	2 in 100 c.c.
Tinctura	Hydrastine	0.4 in 100 c.c.
Hyoscyamus	Mydriatic alkaloids	0.08 per cent.
Extractum	Mydriatic alkaloids	0.3 per cent.
Fluidextractum	Mydriatic alkaloids	0.075 in 100 c.c.
Tinctura	Mydriatic alkaloids	0.007 in 100 c.c.
Ipecacuanha	Alkaloids	2 per cent.
Fluidextractum	Alkaloids	1.75 in 100 c.c.
Nux vomica	Strychnine	1.25 per cent.
Extractum	Strychnine	5 per cent.
Fluidextractum	Strychnine	1 in 100 c.c.
Tinctura	Strychnine	0.1 in 100 c.c.
Opium pulvis and deodorata	Morphine cryst	12 to 12.5 per cent.
Extractum	Morphine cryst	20 per cent.
Tinctura deodorized	Morphine cryst	1.2 to 1.25 in 100 c.c.
Physostigma	Ether soluble alkaloids	0.15 per cent.
Extractum	Ether soluble alkaloids	2 per cent.
Tinctura	Ether soluble alkaloids	0.014 in 100 c. c.
Pilocarpus	Alkaloids	0.5 per cent.
Fluidextractum	Alkaloids	0.4 in 100 c.c.
Stramonium	Mydriatic alkaloids	0.35 per cent.
Fluidextractum	Mydriatic alkaloids	1.4 per cent.
Tinctura	Mydriatic alkaloids	0.35 in 100 c.c.
Extractum	Mydriatic alkaloids	0.03 in 100 c.c.
Scopola	Fluidext alkaloids	0.5 per cent.
	Extract alkaloids	2 per cent.

Aconite—Aconitum, U. S.—Aconite Root—The tuberous Root of Aconitum Napellus, L., Ranunculaceæ. Constituents: Aconitine, not less than 0.5 per cent, napelline, fixed oil, etc. Off. Prep.: Extractum Aconiti; Fluidextractum Aconiti; Tinctura Aconiti (10%).

The tincture of Aconite—formerly 35 per cent—was reduced in the U. S. Ph. VIIIth, to 10 per cent in strength. Great care must be taken that the stronger (U. S. Ph. '90) be not dispensed for the weaker (U. S. Ph. 1905).

Uses.—Formerly in preparing Aconitia, a mixture of the active principles not to be confounded with the official crystallized alkaloid, Aconitine, Duquesnel; An Abstract and a Liniment, once formerly official.

Average Dose.—0.065 Gm. (1 grain).

Belladonna Root—Belladonnæ Radix, U. S.—Root of Atropa Belladonna, L., Solanaceæ. Constituents: Atropine and secondary alkaloid said to be identical with those obtained from Hyoscyamus and Stramonium, total not less than 0.5 per cent. Off. Prep.: Fluidextractum Belladonnæ Radicis.

Uses.—In the preparation of Atropine; the Extract formerly in Belladonna Plaster.

Dose.—0.065 Gm. (1 grain).

Belladonna Leaves—Belladonnæ Folia, U. S.—Leaves of Atropa Belladonna, L., Solanaceæ. Constituents: Same as in the Root, not less than 0.35 per cent. Off. Prep.: Extractum Belladonnæ Foliorum; Tinctura Belladonnæ Foliorum.

Uses.—Similar to the root; and in the official **Belladonna Plaster.**

Dose.—0.065 Gm. (1 grain).

Calumba—(See Group 7.).

Colchicum Corm—Colchici Cormus, U. S.,(Colchici Radix—'90)—Corm of Colchicum autumnale, L., Liliaceæ. Constituents: Colchicine, not less than 0.35 per cent, starch, etc. Off. Prep.: Extractum Colchici Radicis; Vinum Colchici Radicis (U. S. '90).

Uses.—In the preparation of an unofficial Vinegar and Oxymel.

Colchicum Seed—Colchici Semen, U. S.—Seed of Colchicum autumnale, L., Liliaceæ. Constituents: Colchicine, not less than 0.55 per cent, colchiceine, fixed oil. Off. Prep.: Fluidextractum Colchici Seminis; Tinctura Colchici Seminis; Vinum Colchici Seminis.

Colchicum Seed contains fixed oil which is liable to separate and cause turbidity in its preparations; it uses are similar to those of the root.

Average Dose.—0.25 Gm. (4 grains).

Conium—Conium, U. S.—Poison Hemlock. Fruit of Conium maculatum, L., Umbelliferæ. Constituents: Coniine, not less than 0.5 per cent, conhydrine, fixed oil, volatile oil. Off. Prep.: Fluidextractum Conii. Extractum Conii, a Tincture formerly official.

The alkaloid Coniine is very volatile, and Acetic Acid is used in extracting the drug to "fix" it, to prevent its volatilization in the process of concentration which should be effected by a moderately warm heat. The leaves, formerly official, have been discarded, owing to their being often inert.

Dose.—0.2 Gm. (3 grains).

Coca—Coca, U. S.—Erythroxylon, U. S., '80. Leaves of Erythroxylon Coca, Lamarck. Erythroxylaceæ. Constituents: Cocaine and hygrine. Should contain not less than 0.5 per cent ether-soluble Alkaloids. Off. Prep.: Fluidextractum Cocæ: Vinum Cocæ.

Uses.—In the preparation of the alkaloid Cocaine and its salts, chiefly the hydrochloride, largely used as anæsthetic, also in the form of Elixir, Extract, Wine and Infusion. (See Nat. Form.)

Gelsemium—Gelsemium, U. S.—Yellow Jasmine. Rhizome and rootlets of Gelsemium sempervirens, Persoon. Loganiaceæ. Constituents: Volatile oil, gelsemine, gelseminic acid and resin. Off. Prep.: Fluidextractum Gelsemii; Tinctura Gelsemii.

Uses.—"Gelsemin," a resinoid and an Extract (solid) which represents ten times its weight of the drug.

Guarana—Guarana, U. S.—Paste prepared from crushed seeds of Paullinia Cupana, Kunth. Sapindaceæ. Constituents: Caffeine, tannin, saponin and resin. Should contain not less than 3.5 per cent Alkaloids. Off. Prep.: Fluidextractum Guaranæ.

Uses.—In the Various Elixirs, simple and compound. In the powdered form and an Extract, one grain of which represents about four grains of the drug.

Dose.—2 Gm.

Hydrastis—Hydrastis, U. S.—Golden Seal. Rhizome and rootlets of Hydrastis Canadensis, L., Ranunculaceæ. Constituents: Berberine, hydrastine, not less than 2.5 per cent. Off. Prep.: Fluidextractum Hydrastis; Glyceritum Hydrastis; Tinctura Hydrastis.

Uses.—"Hydrastin," a resinoid; a mixture of the active principles chiefly of berberine (hydrochlor). This term is a misnomer, because of the existence of a second alkaloid in this drug to which the term hydrastine has been applied. The so-called "aqueous fluid extract" is similar to the Glycerite; a colorless solution of the alkaloid Hydrastine and an artificial alkaloid, Hydrastinine, are also used.

Dose.—2 Gm.

Hops—Humulus, U. S.—Strobiles of Humulus Lupulus, L., Moraceæ. Constituents: Volatile oil, tannin four per cent, resin, lupuline. Prep.: Tinctura Humuli.

Uses.—As Poultice or Plaster, Infusion; and in the brewing of Beer; also an unofficial Extract and Fluid Extract.

Hyoscyamus.—Hyoscyamus, U. S.—Henbane. Leaves of Hyoscyamus niger, L., Solanaceæ. (Should be collected from plants of the second year's growth.) Constituents: Hyoscyamine, hyoscine and hyoscipicrin. Should contain not less than 0.08 per cent mydriatic alkaloids. Off. Prep.: Extractum Hyoscyami; Fluidextractum Hyoscyami; Tinctura Hyoscyami.

Uses.—In the powdered form, but chiefly in the form of **Extract.**

Dose.—0.5 Gm.

Ipecac.—Ipecacuanha, U. S.—Root of Cephælis Ipecacuanha, A. Richard. Rubiaceæ, known as Rio, Brazilian or Para, and C. acuminata, Karsten, known as Carthagena Ipecac, yielding not less than 2 per cent alkaloids. Constituents: Emetine, ipecacuanhic acid, resin, etc. Off. Prep.: Fluidextractum Ipecacuanhæ; Pulvis Ipecacuanhæ et Opii.

Uses. In the form of powder as a prompt emetic. The **Syrup, Tincture of Ipecac and Opium** and **Wine of Ipecac** (U. S.) are all prepared from the fluid extract.

Dose.—Expectorant 0.065 Gm. (1 grain); Emetic 1 Gm. (15 grains).

Lobelia.—Lobelia, U. S.—Leaves and tops of Lobelia inflata. Campanulaceæ.—Collected after flowering, but before seeds are entirely ripe. Constituents: Lobeline, lobelacrin, lobelic acid and resin. Off. Prep.: Fluidextractum Lobeliæ; Tinctura Lobeliæ.

Uses.—As **Decoction** and Infusion; sometimes in the form of powder; also in a number of Eclectic preparations and the **Vinegar,** formerly official.

Dose.—Emetic 1 Gm.

Pareira.—Pareira, U. S.—Pareira Brava. Root of Chondodendron tomentosum, Ruiz and Pavon. Menispermaceæ. Constituents: Pelosine, resin. Off. Prep.: Fluidextractum Pareiræ.

Uses.—In Decoction and Infusion.

Pepper.—(See Group 4).

Physostigma.—Physostigma, U. S.—Calabar-Bean. Seed of Physostigma venenosum, Balfour. Leguminosæ. Constituents: Physostigmine, calabarine and physosterin. Should contain not less than 0.15 per cent Ether soluble alkaloids. Off. Prep.: Extractum Physostigmatis; Tinctura Physostigmatis.

Uses.—In the preparation of the alkaloid and its official salts.

Dose.—0.065 gm. (1 grain).

Pilocarpus.—Pilocarpus, U. S.—Jaborandi. Leaflets of Pilocarpus microphyllus, Stapf, and P. Jaborandi, Holmes, Rutaceæ. Constituents: Pilocarpine, volatile oil. Should contain not less than 0.5 per cent alkaloids. Off. Prep.: Fluidextractum Pilocarpi.

Uses.—Infusion and in the preparation of the alkaloid Pilocarpine, and its various salts.

Dose.—2 Gm.

Pomegranate.—Granatum, U. S.—Bark of Stem and Root of Punica Granatum, L., Puniaceæ. Constituents: Pelletierine, punicine, tannin, etc.

Uses.—In Decoction, and in the preparation of Pelletierine Tannate, both used as remedies for Taenia.

Dose.—2 Gm.

Sanguinaria.—Sanguinaria, U. S.—Bloodroot. Rhizome of Sanguinaria Canadensis. Papaveraceæ. Constituents: Sanguinarine

one per cent, resins. Off. Prep.: Fluidextractum Sanguinariæ; Tinctura Sanguinariæ.

Uses.—In the form of powder, as a sternutatory and emetic; also in the preparation of an **Extract** and as Decoction and a **Vinegar,** formerly official.

Dose.—Expectorant 0.125; Emetic 1 Gm.

Scoparius.—Scoparius, U. S.—Broom. Tops of Cytisus Scoparius, Link. Leguminosæ. Constituents: Scoparin, sparteine, tannin, volatile oil. Fluidextractum Scoparii.

Uses.—A Decoction and the official alkaloid Sparteine.

Dose.—1 Gm.

Scopola. Scopola, U. S.—Japanese Belladonna Root. The Rhizome of Scopola Carniolica, Jacquin, Solanaceæ.

Constituents: Mydriatic alkaloids similar to Belladonna, not less than 0.5 per cent.

Uses.—As extract for **Belladonna Plaster.**

Dose.—0.065 Gm. (1 grain).

Spigelia.—Spigelia, U. S.—Pink Root. Rhizome and rootlets of Spigelia Marilandica, L., Loganiaceæ. Constituents: Volatile oil, bitter alkaloidal principle, resin. Off. Prep.: Fluidextractum Spigeliæ.

Uses.—Infusion and Decoction, usually associated with purgatives, such as Senna. The **Comp. Fluid Extract Spigelia and Senna** was formerly official for the preparation of "**Worm Syrup.**"

Dose.—4 Gm.

Staphisagria.—Staphisagria, U. S.—Stavesacre. Seeds of Delphinum Staphisagria, L., Rannunculaceæ. Constituents: Delphinine, delphinoidine, delphinine and fixed oil. Off. Prep.: Fluidextractum Staphisagriæ.

Uses.—Chiefly as an **insecticide,** the whole seeds being used, and in the form of Tincture.

Stramonium.—Stramonium U. S.—Stramonii Folia ('90).—Leaves of Datura Stramonium. Solanaceæ. Constituents: Atropine and hyoscyamine, the mixture of the two formerly called daturine not less than 0.35 per cent.

Veratrum.—Veratrum U. S.—Veratrum Viride, '90.—Rhizome and rootlets of Veratrum viride, Aiton (American Hellebone), or V. album L. (White Hellebone), Liliaceæ. Constituents: Jervine, pseudo-jervine, rubijervine, veratroidine and resin. Off. Prep.: Fluidextractum Veratri; Tinctura Veratri. This tincture has been reduced in strength from 40 per cent (U. S. Ph. '90) to **10 per cent,** U. S. Ph. VIIIth. Great care should be taken in not confusing the two Tinctures.

Uses.—A Tincture prepared from the green, or fresh drug, according to the General Formula, Norwood's Tincture.

UNOFFICIAL ALKALOIDAL DRUGS—GROUP EIGHT.

COM. NAME.	BOT. NAME.	PART USED.	CONSTITUENTS.
Achillea (Yarrow)	A. millefolium.	Herb.	Achilleine, resin, volatile oil, tannin.
Alstonia.	A. constricta.	Bark.	Ditaine, ditamine, resin.
Angustura.	Galipea cusparia.	Bark.	Angusturine, resins, vol. oil.
Ash (white)	Fraxinus Americana.	Bark.	Alkaloid, volatile oil.
Baptisia (Wild Indigo.)	Baptisia tinctoria.	Root.	Baptisine, resin, etc.
Barberry.	Berberis, vulgaris, B. aquifolium.	Root or Root br'k R'zome.	Berberine, vinetine, etc.
Boldus.	Boldoa fragrans.	Leaves.	Boldine, resin, volatile oil.
Cevadilla.	Veratrum Sabadilla.	Seeds.	Veratrine, cevadine, cevadillin.
Chelidonium.	C. majus.	Herb.	Chelidonine, etc.
Cicuta.	Cicuta maculata.	Herb.	Cicutine.
Coffee.	Coffæa Arabica.	Seeds.	Caffeine, volatile oil, tannin.
Cuprea Bark.	Remijia pendanculata R. Purdicana.		Quinine and other Cinchona alkaloids.
Delphinium (Lark spur).	D. Consolida.	Seeds.	Delphinine, fixed oil, etc.
Gold Thread.	Coptis trifoliata.	Herb.	Berberine, coptine, resin.
Ignatia.	Strychnos Ignatia.	Seed.	Strychnine, brucine, oil.
Jequiriti	Abrus precatorius.	Seeds.	Alkaloid, abric acid, fixed oil.
Mate	Ilex Paraguensis.	Leaves.	Caffeine, tannin, volatile oil.
Menispernum.	M. Canadense.	R'zome.	Berberine, menispine.
Nectandra.	Nectandra Rodiæi.	Bark.	Berberine, sipirine, etc.
Poppy.	Papaver somniferum.	Fruits.	Opium alkaloids (see Opium.)
Ptelea (wafer-Ash).	Ptelea trifoliata.	Root, bark	Berberine, volatile oil, etc.
Quebracho.	Aspidosperma Q.	Bark.	Aspidospermin, tannin.
Sarracenia (Pitcher plant.)	S. purpurea.	Herb and Root.	Sarracenine, acids.
Scopolia	S. Japonica.	Root.	Atropine, resin.
Stramonium (seed)	Datura S.	Seed.	Hyoscyamine, oil.
Tabacum.	Nicotiana T.	Leaf.	Nicotine, oil, etc.
Theobroma.	Theobroma Cacao.	Seeds.	Caffeine, theobromine, oils.
Veratrum (white Hellebore.)	Veratrum album.	R'zome.	Jervine, pseudo-rubijervine, ver'tr'ibine, etc.
Xanthorrhiza (Yellow root.)	X. apiifolia.	Root.	Berberine.

CLASSIFICATION OF DRUGS.

Group No. 1.

Demulcent Drugs, including those parts of plants whose chief constituents are either Starch, Gum or Sugar or any or all of these together.

Group No. II.

Refrigerant or Acid Saccharine Drugs whose constituents are Sugar associated with some acid such as Tartaric, Citric or Malic Acids.

Group No. III.

Oily Drugs whose principal constituent is a bland Fixed Oil or Fat usually associated with gum, or mucilage.

Group No. IV.

Aromatic Drugs whose chief constituent is a Volatile Oil sometimes associated with a resin.

Group No. V.

Resinous Drugs whose chief constituent is Resin which may be associated with Volatile or acrid Fixed Oil, tannin and bitter principle.

Group No. VI.

Astringent Drugs whose principal constituents are Tannic, or Gallic Acid, or both, sometimes associated with volatile oil, resin or other principles.

Group No. VII.

Glucosidal Drugs in which the most active medicinal constituents are Glucosides or glucosidal. It embraces Drugs furnishing the Neutral or "bitter" principles as well as the Glucosides. Also the class termed Reactionary Drugs.

Group No. VIII.

Alkaloidal Drugs, in which the most active constituents are Alkaloidal, i. e., yielding one or several Alkaloids.

Group No. IX.

Animal Drugs, including medicinal Animals and Animal products and derivatives not otherwise classified.

ANIMAL DRUGS, GROUP IX.

As Animal Drugs are here included those substances of animal origin not heretofore treated of, or classified as having special properties. They embrace:

Whole **animals**, as Cantharis and Coccus.

Secretions, as Musk, Oxgall, Milk, Egg, Isinglass.

The **Ferments** or **Enzymes** Pepsin and Pancreatin.

Antitoxic, Serum: Antidiphtheritic.

The Glands: Suprarenal and Thyroid.

Cantharis.—Cantharis, U. S.—"Spanish Flies." The Beetle, Cantharis vesicatoria, L. Constituents: Cantharidin. Off Prep.: Ceratum Cantharidis; Collodium Cantharidatum: Tinctura Cantharidis, (10%).

Uses.—Chiefly in the form of Cerate for spreading "**Blisters,**" also in Linimentum Cantharidis, formerly official.

Dose.—0.03 Gm. (½ grain).

Cochineal.—Coccus, U. S.—Dried female insect of Pseudococcus cacti; Burmeister. Constituents: Carminic acid. Off. Prep.: Tinctura Cardamomi Comp.

Uses.—In **Comp. Tincture Cochineal,** N. F., for coloring Elixirs and for preparing **Carmine,** a compound of the coloring principle with alumina.

Oxgall.—Fel Bovis, U. S.—"Fel Tauri." Fresh Bile of Bos Taurus, Ruminantia. Constituents: Bilirubin, cholesterin, glycocholic and taurocholic acids.

Fel Bovis Purificatum, U. S.—Insipissated and Purified Oxgall. Prepared by evaporating the liquid Oxgall to one-third its weight, adding an equal volume of Alcohol. The alcoholic solution, freed from the precipitated impurities, is then concentrated by evaporation to a pilular consistence.

Uses.—Exceedingly rare, in pills.

Dose.—0.5 Gm.

Gelatin.—Gelatinum, U. S.—The purified dried product obtained by treating certain animal tissues as Skin, Ligaments, etc., with boiling water.

Gelatinum Glycerinatum, U. S.—Prepared by soaking Gelatin in Water, adding an equal weight of Glycerin straining and evaporating the water so as to obtain a translucent easily soluble mass containing 50 per cent. each Gelatin and Glycerin.

Uses.—In Urethral and Vaginal **Suppositories.**

Suprarenal Glands.—Glandulæ Suprarenalis Siccæ, U. S.—The Suprarenal glands of the Sheep or Ox, freed from fat, cleaned, dried and powdered.

One part of the powder represents about six parts of the fresh fat free glands.

Dose.—0.250 Gm. (4 grains).

Thyroid Glands.—Glandulæ Thyroidæ Siccæ, U. S.—The thyroid glands of the Sheep, freed from fat, cleaned, dried and powdered.

One part of the powder represents about 5 parts of the fresh fat free glands.

Dose.—0.250 Gm. (4 grains).

Musk.—Moschus, U. S.—Dried secretion from preputial follicles of Moschus moschiferus. Constituents: Cholesterin, fat, ammonia, albuminous and gelatinous substances, etc. Off. Prep.: Tinctura Moschi.

Uses.—In **Flavoring** and **Perfumery**; seldom in medicine, as a nervous sedative.

Dose.—0.25 Gm. (4 grains).

Pepsin.—Pepsinum, U. S.—Pure Pepsin. A proteolytic Ferment, or enzyme, obtained from the glandular layer of the fresh Stomach of the Pig. Sus scrofa; the chief digestive principle of the gastric juice.

It should be capable of digesting not less than 3,000 times its own weight of freshly coagulated and disintegrated **Albumen** when tested by the official process.

Pepsin is obtained from the finely comminuted **inner** lining, or membrane of the Hog's stomach by macerating it in Water containing about 2 per cent Hydrochloric Acid, expressing and filtering the liquid and obtaining the pepsin either by **precipitation** with Sodium Chloride, collecting and drying the flocculent precipitate, or neutralizing the liquid, concentrating it a low temperature to a syrupy consistence, spreading the liquid on glass-plates and drying, so as to obtain the pepsin in **scales.** This latter furnishes the **soluble** pepsin, the kind now mostly used.

Pepsinum saccharatum.—Saccharated Pepsin of the strength of 1 in 10 of Milk Sugar, 1 gr. dissolving 300 grs. albumen was formerly official.

The **valuation** of Pepsin consists in determining its **proteolytic** power, or the ratio of its decomposing or digestive effect upon proteids, especially albumen and fibrin. Pepsin in acid solution and at the body temperature, 38° to 40°C., (100 to 104°F.) digests proteid substances, converting them into a soluble, readily assimilable form called **peptone.**

The **process of assay** consists in adding 10 Gm. freshly coagulated and prepared Egg-white to 100 C. C. of Water containing 2 C. C. of Dilute Hydrochloric Acid and 1-3 cg. (1-20 gr.) of Pepsin, heated to 52°C. The mixture is kept at this temperature and agitated every 15 minutes, when, at the expiration of 2½ hours practically all the Albumen should be digested and have resulted in an almost clear solution. By varying the strength of the solutions, the variation in power of any pepsin may be ascertained.

Pancreatin.—Pancreatinum, U. S.—A mixture of Enzymes naturally existing in the Pancreas (sweetbread) of warm-blooded animals, usually from that of the Hog or Ox, and consisting principally of amylopsin, myopsin, trypsin and steapsin, and capable of converting not less than 25 times its weight of starch into water-soluble substances.

It is prepared by different methods: By maceration with acidulated Water, neutralization with Calcium Carbonate, precipitation of the clear liquid with Alcohol, collecting, drying and mixing the residue with Sugar of Milk, or by extraction, freed from fat by Ether and drying on plates of glass.

Pancreatin peptonizes milk, and 0.28 of it dissolved in 100 C. C. of tepid Water, with 1.5 of Sodium Bicarbonate, added to 400 C. C. of Milk, heated to 40°C. and the mixture maintained at this temperature for thirty minutes, the milk should be so completely peptonized that a little of it, transferred to a test-tube, should show no coagulation with Nitric Acid.

Ptyalin.—A Ferment present in the Saliva; has the same properties as **Diastase,** obtained from malt.

Uses. The above three Principles represent the three fermentative stages of the process of digestion.

Ptyalin has amylolotic properties, that is, converts Starch and Carbohydrates generally into **glucose**, into which all amyloid and saccharine substances must be changed before they can be assimilated.

Pepsin, secreted by the stomach, in conjunction with Hydrochloric Acid (and Lactic Acid) digests all albuminous substances into the form necessary to their assimilation, **peptone.**

Pancreatin is a mixture of principles representing the properties of the two preceding Ferments and in addition possesses the property in alkaline media to **emulsify** Fats, thus facilitating their assimilation.

The Pulvis Pepsini Compositus, N. F., "Pulvis Digestivus," is a mixture of the different principles with Milk Sugar and Hydrochloric and Lactic Acids to represent the Digestive Fluids in their natural proportions. Pepsin is largely used in the powdered form, also in tablets, etc., in Elixirs, Wines, Glycerite, and Solutions. (See Nat. Formulary.)

Milk.—Lac Vaccinum.—Secretion of the character of an Emulsion obtained from the Cow yields an organic acid:

Lactic Acid.—$HC_3H_5O_3$.—Acidum Lacticum, U. S.—Containing 75 per cent by weight of absolute acid; sp. gr. 1.206.

It is formed in Milk when it sours by the fermentation of the Sugar of Milk, and may be formed in solutions of various other Sugars by fermentation in the presence of casein and certain other proteid compounds resembling it. The Lactic Acid so formed is combined with Calcium or Zinc, the Lactate separated and decomposed by strong Acids which set the Lactic Acid free.

A syrupy liquid miscible in all proportions with water, alcohol and ether, but not with benzin or chloroform.

Dose.—2 cc.

Off. Prep.—Syrupus Calcii Lactophosphatis.

Yolk of Egg.—Vitellus, U. S. '90.—Yolk of Egg of Gallus Bankiva, var. domesticus, Temminck. Constituents: Vitellin, fixed oil, inorganic salts, etc. Prep.: Glyceritum Vitelli or Glyconin formerly official.

Uses.—For preparing **Emulsions**, especially with strongly alcoholic liquids, for example, spirit nitrous ether, in which Acacia would precipitate.

Antidiphtheritic Serum.—Serum Antidiphtheriticum U. S.—Diphtheria Antitoxin.—The serum or fluid separated from the Blood of the Horse, by coagulation immunized through inoculation of diphtheritic toxin.

It should be kept in hermetically sealed glass containers in a dark place at a temperature between 4.5 to 15°C.

Average Dose. 3000 units.

Immunizing Dose for a well person 500 units.

These standards are fixed by the U. S. Public Health and Marine Hospital Service at the Hygienic Laboratory in Washington, D. C.

Artificial Alkaloids.

The **Pyridin** bases obtained from the tarry residue in the destructive distillation of Nitrogenous substances, such as Bone, or made synthetically. They are colorless, strongly alkaline liquids of penetrating odor, forming salts with acids. The most important are:

Pyridin.—C_5H_5N—and its homologue **Pyrrol**, C_4H_4NH.

Iodol.—C_4I_4NH.—Tetra iodo pyrrol. Made by mixing alcoholic solutions of Pyrrol and Iodine and separating the Iodol by the addition of water. Contains 98% iodine.

Uses.—As an inodorous substitute for Iodoform.

The **Chinolin** bases—Chinoline C_9H_7N—a colorless liquid, forming salts with acids; the Tartrate has been used. Also a number of derivatives.

Kairin.—$C_{11}H_{15}NO.HCl$.—Known as "A" and "M."

Thallin.—$C_9H_9(OCH_3)NH$.—From Paranitrophenol. The Sulphate; soluble in 7 water; 100 alcohol.

Animal Alkaloids.

From fresh meat an alkaloid **creatinin** $C_5H_{10}N_4O$ has been obtained and a number of derivatives of it.

Ptomaines, also called Septicine, are alkaloids produced in the Cadaver by decomposition of albumen or as the result of bacterial changes. Some are exceedingly poisonous, others are non-poisonous.

QUESTIONS ON LECTURE X.—SERIES 21.

Important.

Students will answer these questions on **letter-size** paper, **in ink,** writing only on **one** side of the paper, and forward promptly to the Director, signed. In answering, it is **not** necessary to repeat the question itself, but only the number of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

In order to insure prompt attention, all the rules of the "Important Notice" must be complied with.

The Director.

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1. Define an Alkaloid.
2. What is an **alkaloidal** Drug?
3. How do Alkaloids differ from the Glucosides?
4. Mention the General Method for the **extraction** and **isolation** of Alkaloids.
5. Name 5 **official alkaloids.**
6. Name 4 liquid Alkaloids; how do these differ from solid Alkaloids?
7. How does the **solubility** of Alkaloids compare with that of their Salts?
8. In what form do Alkaloids exist naturally?
9. Mention the official Cinchona Alkaloids.
10. What is Mayer's Solution, and what is its **use?**
11. What is Grahe's Test, and what is its **object?**
12. Define Cinchona, U. S. Ph. viii.
13. What **varieties** of Cinchona are official, and what plants are they obtained from, respectively?
14. Outline the **assay** process for Cinchona Alkaloids.
15. How may the presence of other Cinchona alkaloids in Quinine and its Salts be **detected?**
16. What is the **medicinal** use of Quinine, and its Salts, and what is the **dose?**
17. Name the two Tests depending on **color reactions** through which Quinine is distinguished from the other alkaloids.
18. Which is the most soluble of the quinine salts?
19. Mention ten official **preparations** of Opium, and their Drug-Strengths.

20. Mention the official **forms** of Opium and their alkaloidal Strength.

21. Name the **official** alkaloids of opium and the dose of **each.**

22. What powerful **emetic** is made from morphine and what is its **dose?**

23. What is the characteristic color reaction of Morphine and nitric acid?

24. Name 2 of the most important **unofficial** Alkaloids of Opium; their properties.

25. How is Opium deodorized?

26. How does Morphine **differ** in its behavior with Potassa and Soda from other Alkaloids?

27. What is the **pharmacopœial requirement** of Nux Vomica?

28. Mention the **Official Preparations** of Nux Vomica, their **strengths.**

29. Mention the most characteristics **identity** Test for Strychnine.

30. What phenomenon is observed in an **acid** solution of Quinine and Quinidine?

31. What is meant by the term **Mydriatic?** (b) Name the most important **mydriatic alkaloid.**

32. What is Eserine?

33. Give the source of Veratrine. (b) Name its official preparations.

34. Mention two official Animal Ferments, and state under what **conditions** each is alone active. How does the Pharmacopœia direct that the Strength of these shall be **ascertained?**

35. Name the official Animal Glands. (b) For what used?

36. Give the **dose** of Antidiphtheritic Serum. (b) What is the source of this Serum? (c) What precaution necessary in storing it?

PREPARATIONS OF THE U. S. PH.

SOLUTIONS.

Solutions may be divided, according to the character of the solvent employed, into groups of **aqueous**, **alcoholic**, **saccharine** and **ethereal** solutions, and Glycerites and Oleates.

The Aqueous solutions embrace two classes: The Waters and the Liquors or pharmacopœial Solutions.

WATERS—AQUÆ.

The Waters are solutions of **volatile** substances in Water.

The nineteen official Waters may be divided, according to their character or method of preparation, as follows:

1. Natural Waters:

Aqua.—Water, H_2O.—Natural water in its purest attainable state.

2. The Aromatic Waters.—Solutions of Essential Oils or other **volatile** principles in Water. With one exception (Aq. Amygdal. am.), they are saturated solutions and are as follows:

(a) By simple solution.

Aqua:		In 100 cc.
Amygdalæ Amaræ	bitter almond oil	0.1
Creosoti	creosote	.1.
Chloroformi	chloroform (in excess) about	0.5
Aurantii Florum	dist. water	50.
	stronger orange flower water	50.
Rosæ	dist. water 50, stronger rose water	50.

(b) Solution by intervention of Purified Talc and filtration:

Aqua:		In 100 cc.
Anisi	anise oil	0.2
Cinnamomi	cinnamon oil	0.2
Fœniculi	fennel oil	0.2
Menthæ Piperitæ	peppermint oil	0.2
Menthæ Viridis	spearmint oil	0.2
Camphoræ	alcohol 0.5, camphor	0.8

The oils are triturated with twice their weight of Purified Talc, the water gradually added and the mixture filtered. Camphor is first reduced to powder with a little **alcohol.**

The Aromatic Waters may also be prepared by the **hot-water** method: Introducing the Oil, dropped on a folded filter, in hot water, shaking the container, allowing it to stand until thoroughly cold and obtaining the water by filtration.

(c) By distillation:

Aqua Destillata.—Distilled Water.—By distilling Water, rejecting the first 10 per cent of the distillate, collecting the succeeding 80 per cent and preserving it in bottles, loosely stoppered with cotton.

Aqua Hamamelidis.—Distilled Witch Hazel Water.

Hamamelis Bark 100 Gm. is macerated in water 200 cc. for 24 hours, then distilled until 85 cc. distillate is obtained to which alcohol 15 cc. is added, or to make 100 cc.

Aqua Aurantii Florum Fortior. Aqua Rosæ Fortior.

These are made by distillation from the fresh Orange flowers and Rose leaves, respectively, and obtained chiefly as **by-products** in the manufacture of their essential oils.

3. Chemical Waters.—Solutions of Gases in Water, made by chemical reaction and **absorption**. All but Ammonia Water are saturated solutions:

	Sp. gr.	% by w't.
Aqua Ammoniæ	0.958	NH_3—10.
Ammoniæ fortior	0.897	NH_3—28.
Hydrogenii Dioxidi	1 vol. eq. 10 vols. O	H_2O_2— 3.

The preparation of these and the reactions involved have been described under the Elements from which they are respectively produced.

SOLUTIONS—LIQUORES.

The twenty-five official Solutions are, with three exceptions, solutions of **non-volatile** substances, chemical salts, in Water. They are divided into two Groups:

(1) Simple solutions. (2) Chemical solutions.

1. Simple Solutions are prepared by dissolving the substance in water. Three are prepared by volume:

Liquor:		In 100 cc.
Acidi Arsenosi	(HCl 5) arsenic trioxide	1.
Antisepticus	benzoic acid 0.1, boric acid	2.
	eucalyptol 0.025, thymol	0.1
	oils thyme 0.01, gaulther 0.025, mint	0.05
	alcohol	25.
Arseni et. Hydrargyri Iodidi	arsenic iodide	1.
(Donovan's)	mercuric iodide	1.
Cresolis Compositus	cresol	50.
	KOH 8, water 5, linseed oil	35.
Sodii Arsenatis	dried sodium arsenate	1.
		% by w't.
Iodi Comp.	potassium iodide 10, iodine	5.

2. Chemical Solutions: These include all those solutions made by forming new chemical compounds, either by double decomposition, direct union or other chemical methods.

The weaker of these being used internally, are prepared by **volume**; the stronger ones, chiefly used for preparations, are made by **weight**.

Liquor:		In 100 cc.
Ammonii Acetatis	dilute acetic acid, amon. carb..	5.
Calcis	lime 0.3, $Ca(OH)_2$	0.14
Chlori Comp.	potass. chlor. 0.5, acid hc'l. 1.8—Cl.	0.4
Ferri et Ammonii Acetatis	sol. amon. acet.	50.
(Basham's Mixture)	dil. acetic acid 6, tr.. ferric chl.	4.
	arom. elixir 12, glycerin	12.

Liquor:		In 100 cc.
Potassii Arsenitis	potass. bicarb 2, arsenic trioxide	1.
Fowler's)	tinct. lavender comp.	3.
Potassii Citratis	citric acid 6, potass. bicarb	8.
Magnesii Citratis	magnes. carb. 15, citric acid	33.
	syrup citric acid 60, potass. bicarb.	2.5
water to 350 cc. for one bottle.		
Sodii Phosphatis Comp.	sodium phosphate	100.
	sodium nitrate 4, citric acid	13.

Liquor:		% by w't.	Sp. gr.
Formaldehydi	formaldehyde H.COH	37.	
Hydrargyri Nitratis	red mercuric oxide 40,		
	HNO_3 45, $Hg(NO_3)_2$	60.	2.08
Plumbi Subacetatis	lead acet. 17, lead oxide 10	25.	1.23
Plumbi Subacetatis dilutus	sol. lead subacetate	4.	
Potassii Hydroxidum	KOH	6.	1.04
Sodii Hydroxidum	NaOH	5.	1.05
Sodæ Chlorinatæ	sod. carb., lime chlorin 9, Cl	2.6	1.05
Zinci Chloridi	zinc 24, HCl 84, HNO_3 1.2, $ZnCl_2$	50.	1.54

The Iron Solutions are made from the Sulphate and by acting on the metal with Hydrochloric Acid to produce the Chloride.

These **ferrous** salts are oxidized into **ferric** salts by Nitric Acid:

Liquor:		% by w't.	Sp. gr.
Ferri Chloridi	HCl 5, $FeCl_3$	29.	1.31
Ferri Subsulphatis	(Monsell's) subsulphate	43.7	1.54
Ferri Tersulphatis	$Fe_2(SO_4)_3$	36.	1.43

By precipitation with Ammonia Water, washing, etc.:

Ferric Hydrate, $Fe_2(OH)_6$, from which, by solution in their respective Acids the following formerly official are produced:

Liquor: Ferri Acetatis, Ferri Citratis, Ferri Nitratis.

From the solution of the Citrate, the scaled salts are prepared. All the solutions of iron have a characteristic reddish-brown color, except that of the Nitrate, which is amber-colored.

SPIRITS—SPIRITUS.

The Spirits are Alcoholic solutions of **volatile** substances.

Of the 20 official, two are "natural" spirits (made by distillation: Spiritus Frumenti and Sp. Vini Gallici and are treated of as "Products by Fermentation"), fifteen are solutions of essen-

tial oils and called "Aromatic Spirits," or, when used for flavoring, "essences."

1. Natural Spirits, by distillation:	% by w't.	% by vol.
Spiritus Frumenti containing alcohol	37 to 47	44 to 55
Spiritus Vini Gallici containing alcohol	39 to 47	46 to 55

2. Made by solution:		In 100 cc.
Spiritus Ætheris	ether $(C_2H_5)_2O$	32.5
Spiritus Ætheris Comp. (Hoffmann's anodyne)	ethereal oil 2.5, ether	32.5
Spiritus Chloroformi	chloroform	6.

Aromatic Spirits or "Essences."

Spiritus:		In 100 cc.
Amygdalæ Amaræ (water 20)	bitter almond oil	1.
Anisi	anise oil	10.
Aurantii Comp	orange oil	20.
	oils, anise 0.5; coriander 2, lemon oil	5.
Camphoræ	camphor	10.
Cinnamomi	cinnamon oil	10.
Gaultheriæ	wintergreen oil	5.
Juniperi	juniper oil	5.
Juniperi comp. (water 30)	juniper oil	0.4
	oils, caraway, fennel, each	0.05
Lavandulæ	lavender oil	5.
Menthæ Piperitæ	peppermint herb 1, oil	10.
Menthæ Viridis	spearmint herb 1, oil	10.
3. By chemical reaction and solution:		
Spiritus Ammoniæ Aromaticus	water 14, amon. water	9.
	amon. carb.	3.4
	oils, lavender, nutmeg each 0.1; lemon oil	1.
Spiritus Glycerylis Nitratis	nitroglycerin, $C_3H_5(NO_3)_3$	1.
5. By distillation and absorption (from amon. water, stronger):		
Spiritus Ammoniæ	amon, gas, NH_3	10.
Spiritus Ætheris Nitrosi (yielding 11 times its vol. of NO.)	ethyl nitrite	4.

From reaction of Sulphuric Acid on Sodium Nitrite in Alcohol:

$NaNO_2+H_2SO_4=HNO_2+NaHSO_4$: $C_2H_5OH+HNO_2=C_2H_5NO_2+H_2O$.

The Nitrous Ether is separated from the accompanying alcohol by washing with ice-cold water and traces of acid by agitation with an ice-cold solution of Sodium Carbonate, then freed from adhering water by shaking it with Potassium Carbonate and filtered in a tared bottle containing the alcohol.

The strength of Ethyl Nitrite is determined by measuring the volume of Nitrogen Dioxide (NO) given off, when decomposed by Potassium Iodide and Sulphuric Acid in an instrument termed a **nitrometer.**

$C_2H_5NO_2+KI+H_2SO_4=C_2H_5OH+KHSO_4+I+NO$.

SYRUPS—SYRUPI.

The official Syrups are nearly **saturated** solutions of Sugar in Water, in which aromatic or medicinal substances are dissolved.

The official Syrup contains 65 per cent by weight, 85 per cent by volume, of Sugar (about 7 lbs. av. in 1 Gallon): with a smaller proportion of Sugar the syrup undergoes fermentation (spoils).

The "Medicated Syrups" contain less syrup owing to the solution of the medicinal substances which usually reduce the solubility of the sugar in the liquid from which the syrup is prepared. Syrups should be made in small quantities and be kept in a **cool place**, in cork-stoppered bottles which should be sterilized before being filled in order to **preserve** them.

The thirty-two official Syrups are made by different methods: By solution, or mixing the medicinal substance with the syrup; by dissolving the Sugar in the medicinal solution; by extraction from the drug and by chemical reaction and solution.

The methods of dissolving the Sugar are also of importance; in some it is dissolved **without heat**, in others **with heat** and with some others by **boiling** heat.

(1) By Solution of Sugar in the liquid:

Syrupus..Sugar 850 Gm.; Distilled Water, to make 1000 cc.

Without heat:

Syrupus Aurantii Florum......................Sugar 850 Gm.
Orange Flower Water to make 1000 cc.

(2) By mixing a Solution with Syrup to make cc. 100.

Syrupus:	In 100 cc.—%	
Acaciæ	water, 43, acacia	12.5
Acidi Citrici	tr. lemon 1, water 1, ac. citric	1.
Ipecacuanhæ	ac. acetic 1, glyc. 10, fluidextract	7.
Amygdadæ	orange flower 10, sp. bitter almond	1.
Krameriæ	fluidextract	45.
Lactucarii, orange fl. water 5, ac. citric 0.1, glycerin 20,	tr. lactuc	10.
Rhei	sp. cinna. 0.4, pot. carb. 1, water 5, fluidextract	10.
Rhei Aromaticus	pot. carb. 0.1, rhubarb arom.	15.
Rosæ	acid sulph. dil. 1, fluidextract	12.5
Rubi	fluidextract	25.
Scillæ	vinegar squill	45.
Senegæ	fluidextract	20.
Sennæ	oil coriander 0.5, fluidextract	20.

By solution and filtration:

Sugar dissolved by heat:

Syrupus:	% by vol.	
Sarsaparillæ Comp.	fl. ext. sarsaparilla	20.
	fl. ext. glycyrrh. senna, each	1.5
	oils, sassafras, anise, gaultheria, each	0.01

By solution, filtration with Purified Talc:

Solution of Sugar without heat:

Syrupus:		In 100 cc.
Scillæ Comp.	fluid extract squill, senega each	8.
(Coxe's Hive Syrup)	Antimony and potassium tartrate	0.2

By solution, filtration with Magnesium Carbonate:

Syrupus:

Aurantii	acid citric 0.5, tr. orange	5.
Picis Liquidæ	alcohol 5, washed tar	0.5
Tolutanus	tincture tolu	5.
Zingiberis	alcohol 2, fluidextract	3.

(3) By extraction:

Sugar dissolved without heat:

Syrupus:

Pruni Virginianæ	glycerin 15, wild cherry	15.

(4) Chemical Syrups:

By simple solution:

Sugar dissolved without heat:

Syrupus:

Acidi Hydriodici	water 30, acid hydriodic dil.	10.
Ferri Quininæ et Strychinæ Phosphatum	glycerite	25.
Hypophosphitum	calcium hypophosphite	4.5
	potassium, sodium hypophosphite each	1.5
	tr. lemon 0.5, acid hypophos. dil.	0.2
Hypophosphitum compositum.		
	Hypophosphites sod., potas. ea. 1.75, calc.	3.5
	" iron, manganese, ea. 0.225, sod. cit.	0.3
	acid Hypophos dil. 2.5 strychnine 0.0115, quinin	0.11

By chemical reaction and solution:

Sugar dissolved without heat:

Syrupus Calcii Lactophosphatis....calcium lactophosphate 1.

Calc. carb. 25 dissolved in Acid Lactic 60 cc. Water 100; add Acid Phosphoric 36 cc. water 150; filter to 425.

Orange flower water 25, Sugar 700 G. to make 1,000 cc.

Sugar dissolved by boiling heat:

Syrupus Calcis ....calcium saccharate 1.

Lime 65, Sugar 400, add to boiling Water 500 cc.

Boil 5 minutes; strain, dilute with Water, filter, evaporate to 700 cc., when cool add Water to make 1,000 cc.

Syrupus Ferri Iodidi ....ferrous iodide, FeI_2 5.

Iron wire 12.5, Water dist, 150, add Iodine 41.5; after complete reaction boil, filter, dissolve Sugar 600, add Dilute Hypophosphorous Acid 20 cc. and Water to 1,000 Gm.

HONEYS—MELLITA.

There is only one medicated Honey official.

Mel or crude honey and **Mel Depuratum** or clarified honey are described under "Sugars."

Mel Rosæ.—Honey of Rose, flext. rose 12, clarified Honey to make 100 Gm.

ELIXIRS—ELIXIRIA.

Elixirs are a class of elegant preparations similar to wines or cordials, composed of Water, Sugar, Alcohol and Aromatics.

The medicinal substances are usually in such proportion that an ordinary dose may be contained in one or two teaspoonfuls (4 to 8 cc.) of the elixir.

There are three Elixirs official: Aromatic Elixir and Adjuvant Elixir, which serve as vehicles, and one medicinal Elixir.

Elixir Aromaticum	spirit of orange comp.	12 cc.
mix with	alcohol, to make	250 cc.
to this solution add in several portions, agitating after each addition	syrup	375 cc.
and in the same manner	water	375 cc.
mix the liquid with	purified talc	30 G.
and filter adding	water 3, alcohol 1, to make	1000 cc.

This illustrates the method by which Elixirs are made. Medicinal ingredients are dissolved in the water, or alcohol, as indicated by their solubilities, before mixing the alcoholic solution of oils with the saccharine solution.

Elixir Ferri, Quininæ et Strychninæ, Phosphatum.

Prepare solutions separately:

a. Quinine, alkaloid	Gm	0.875
Strychnine, alkaloid	Gm.	0.0275
Dissolve in Alcohol	cc	6
Add Acid Prosphoric cc 0.2, Elixir Arom.		35
b. Ammonium Carbonate	Gm	0.9
Dissolve in Acid Acetic	Gm	2.87
Neutralize with NH_4OH, add Water, to	cc	5
c. Mix a. and b.; add Elixir Aromatic, to	cc	88
d. Soluble Ferric Phosphate	Gm	1.75
Dissolve, with heat, in Water	cc	3
If acid, neutralize with NH_4OH exactly.		
Add Elixir Aromatic to	cc	12
Mix d. with c., filter, add Elixir, to	cc	100

Some salts and fluid extracts may be dissolved in or mixed with the elixir itself.

Elixir Adjuvans	flext. glycyrrhiz	12 cc.
	Aromatic Elixir to	100 cc.

Glycerites—Glycerita.

The Glycerites or "Glyceroles," are solutions of substances in Glycerin.

There are six Glycerites official and they are classified, according to the methods of preparation, as follows:

By solution: In 100 cc.

Glyceritum Phenolis ....liquefied phenol 20.

Ferri Quininæ et Strychninæ phosphatum.

soluble ferric phosphate 8.

dissolve by heat in.......... ....water 20.

add........................quinine 10.4, strychnine 0.08

dissolved in..........................phosphoric acid 20.

add..................water to 50, then glycerin, to 100.

By solution with heat: % by w't.

Glyceritum Acidi Tannici...................acid tannic 20.

Glyceritum Amyli ....water 10, starch 10.

By extraction, evaporation and solution:

Glyceritum Hydrastis ....hydrastis 100.

The liquid extract obtained by exhausting the drug with Alcohol is concentrated by evaporation and added to ice cold Water 50. The liquid is filtered and Water added to 50. This is mixed with Glycerin to 100.

By chemical reaction and solution:

Glyceritum Boroglycerini—Glycerite of Boroglycerin—boroglyceride, or glyceryl borate, 50 per cent by weight.

Glycerin 46 G., heated to 150°C., Boric Acid 31 G., added in portions and heated until reaction ceases and product weighs 50 G.; add Glycerin to 100 G.

OLEATES—OLEATA.

The five official Oleates are compounds obtained by direct action of **Oleic Acid** on the respective **Bases** in the presence of water or alcohol, by trituration in a warm mortar.

There is one **metallic** Oleate which is a semi-solid; four are of **Alkaloids** and three of these contain about one-half their weight of **Olive Oil** to aid in their penetration.

They are distinct from the solid oleates which are made by double decomposition of salts of the metals and alkaline earths and sodium oleate or stearate, or Soap. (See Soap.)

Gm. in 100.

Oleatum Hydrargyri ....yellow mercuric oxide 25.

Oleatum Quininæ ....quinine 25.

containing about one-half Olive Oil:

Oleatum Atropinæ ....atropine 2.

Oleatum Cocainæ ....cocaine 5.

Oleatum Veratrinæ ....veratrin 2.

COLLODIONS—COLLODIA.

These preparations are made by adding medicinal agents to Collodion (see Pyroxylin). They are prepared:

By solution:

Collodium ....solution in ether 75, alcol. 25, pyroxylin 4.
Collodium Flexile..........castor oil 3, Canada turpentine 5.
Collodium Stypticum.......alcol. 5, ether 25, acid tann. 20.

By extraction, evaporation and solution:

Collodium Cantharidatum ....cantharides 60.

The Cantharides is extracted with Chloroform, the liquid concentrated to 15 cc. and mixed with Flexible Collodium to 100.

THE MIXTURES.

The second division embraces such liquid preparations as are not clear solutions and also solutions made by solvents other than those included in the division of Solutions and ineligible to classification according to the solvents.

They are represented by three classes: Mixtures, Emulsions and Liniments.

Mixtures—Misturæ.

The four official mixtures are liquid preparations, for internal use, of medicinal substances, dissolved or suspended in water, containing **sugar, gum**, or **glycerin**. They should be prepared extemporaneously.

By solution: % vol.

(Brown Mixture) Spirit ether nitros 3, wine antimony 6.
tinct. opium camph. 12.
syrup 5, acacia 3, water, to 100.
Mistura Rhei et Sodæ..........sodium bicarbonate 3.5
flexts. ipecac 0.3, rhubarb 1.5
spirit peppermint 3.5, glycerin 35, water, to 100.

By suspension:

Mistura Cretæ........ ....comp. chalk powder 20.
(Chalk Mixture) cinnamon water 40, water, to 100.

By chemical reaction and solution:

Mistura Ferri Comp..myrrh, sugar, ea. 1.8, potass. carb. 0.8
triturate with rose water 70, sp. lavend. 6.
(Griffith's Mixt.) ferrous sulph. 0.6 and rose water to 100.

Emulsions—Emulsa.

Emulsions are liquid preparations consisting of **oily, fatty, resinous**, or otherwise **insoluble** substances suspended in watery liquids by the intervention of gum, mucilage or other viscid material called **emulsifying agents.**

They may be divided into (1) Natural and (2) Artificial Emulsions.

Natural Emulsions comprise products of animal or vegetable origin, consisting of oily or resinous substances so combined with gum or albumen as to be readily **miscible with water** without separation.

Of animal products, **Milk** and **Egg Yolk**, are the most typical emulsions, since their fat-globules are so finely divided and so perfectly distributed in the watery liquid as to require considerable agitation to separate them from the albuminous envelope, in order to obtain the fat. The operation of "churning" milk to produce Butter is a good illustration of this and is the **reverse** of the process of emulsification.

The **milk-juice** of many plants, consisting of oil and gum or albumen, is deposited in fruits and seeds upon evaporation of the water. The **nuts**, especially Almonds, are rich in this mixture, which, upon trituration with water, is restored to its original form of milk-juice or emulsion. The official Almond Emulsion is a good example.

Associated with resin and sometimes with ethereal oil, the milk-juice of many plants exudes and dries into semi-solid masses or **tears**. Examples of these we have in the **Gum-Resin** Asafœtida, which furnishes an official emulsion by trituration in a mortar with Water.

The amount of gum contained in a Gum-Resin is not always sufficient to emulsify the other constituents, resin and ethereal oil, and it is then necessary to add gum **artificially** in order to produce complete emulsification.

These Natural products are the most **perfect emulsions**, and to simulate them is the object of pharmacal art. A natural emulsion may be greatly diluted with water without causing separation of the oil. This is the best test to indicate that an emulsion is **perfect**.

Artificial Emulsions.

These are made by thoroughly mixing the Oil with the emulsifying agent, adding a certain proportion of Water and triturating the mixture in a Mortar or agitating it in a Flask.

There are various methods, but these are general rules:

The emulsification of the oil should be **complete** before the mixture is made up to the required measure.

When Alcoholic liquids are to be added, they should first be **diluted** as much as possible with water or watery liquids.

Salts should be dissolved before being added.

No heat should be employed, as the oil separates in an emulsion when heated.

Emulsions should be **freshly** prepared and be preserved in a **cold** place.

The most common Emulsifying Agents, in the order of their general value, are:

Powdered Acacia: To the powdered Gum, contained in a capacious flat-bottomed, mortar, the oil is gradually added and thoroughly mixed. To this **one and a half times as much** Water

as of Gum is added **all at one time** and the mixture rapidly triturated with a rotary motion of the pestle. Soon the mixture becomes stiff and assumes a milk-white color, the pestle-motion producing a characteristic "crackling" sound, when the emulsification is complete. This so-called "mother-emulsion" may now be diluted to the required measure and other ingredients, flavors, etc., be added.

The **proportion** of Gum required varies with different Oils, an oil rich in gum, such as Castor Oil, requiring **less** gum than an oil poor in natural gum, as Cod Liver Oil.

The following proportions hardly ever fail to produce complete emulsification: Gum, 2 parts; oil, 4 parts; water, 3 parts.

When a **lesser** proportion of Gum is used the water must be decreased in proportion, viz.: One and a half times as much water as of gum.

Ethereal or **Volatile Oils** require a much **larger** proportion of Gum than the fixed oils.

Powdered Tragacanth is used in the same way, or as mucilage, but it does not produce as permanent emulsions as does gum acacia.

Mucilage of Acacia or of **Irish Moss (N. F.)** while producing good emulsions the division of the oil-globules is not as thorough as with the powdered gum, the mixture more rapidly separating into a heavier, watery liquid and a lighter, thick gelatinous emulsion, which requires thorough mixing before use.

Extract of Malt is an excellent emulsifying agent, when its use is admissible. The oil should be added to the Malt Extract, contained in a capacious mortar and incorporated in small quantities at the time. A good article will emulsify an equal volume of Cod Liver Oil.

"Condensed" **Milk** and **Egg-yolk** produce the most perfect emulsions and also the most palatable, but since they rapidly ferment and spoil they should be used **extemporaneously** only.

Glycerin and **sugar** added to emulsions for the purpose of preservation and palatability induce separation and their use is not advisable.

Emulsification "by **intervention**" is the best and only reliable method to be employed with Ethereal Oils and all substances of themselves not emulsifiable. It is illustrated in the official Chloroform and Turpentine Oil Emulsions.

Oil of Turpentine and a little bland fixed oil (Almond Oil) are shaken in a Flask with some powdered acacia until thoroughly mixed; a certain amount of Water is added and vigorously shaken till incorporated and emulsification is complete, syrup and other ingredients are then gradually added and mixed.

Pancreatin emulsionizes fats in preparing them for digestion, but it does not produce a permanent emulsion when used artificially. While, therefore, not a reliable emulsifying agent, it aids the assimilation of oils and its addition to emulsions is sometimes therapeutically desirable. As it is only active in alkaline media the Emulsion should be prepared with a little Sodium Bicarbonate.

The addition of **Alkalies** to emulsions should be avoided. **Soaps** are not Emulsions; neither is the use of **Soap-Bark** to be recommended.

The four official Emulsions may be classified as follows:

Natural Emulsions:

From Gum resin triturated with water:

		% vol.
Emulsum Asafœtidæ...	....asafetida, in select tears	4.

From seed by intervention:

Emulsum Amygdalæ	sweet almond	6.
	sugar 3, acacia powd.	1.

With Powdered Gum Acacia:

Emulsum Olei Morrhuæ................	cod liver oil	50.
	acacia powd.	12.5
	water 25, syrup 10, ol. gaulth	0.4
Emulsum Olei Morrhuæ cum Hypophosphitibus.		
	Acacia powd. 12.5, cod liver oil	50.
	Hypophos Calc. 1., potass sod, ea	0.5
	Syrup 10, ol gaulth	0.4

Artificial emulsion by intervention:

Emulsum Chloroformi.....	tragacanth 1.5, chloroform	4.
	expressed oil almond 6, water, to	100.

Shake Chloroform and tragacanth together in a dry bottle, incorporate 25 cc. Water, then the Almond oil and the remainder of the Water.

Emulsum Olei Terebinthinæ	rect. ol. terpent.	15.
	acacia powd. 15, ol almond	5.
	Syrup 25, water to	100.

Liniments—Linimenta.

The Liniments are liquid preparations for external use consisting of solutions of **oily** or **resinous** constituents in Alcohol or Oils; or mixtures of liquid Soaps. The nine official are prepared:

By solution:

Linimentum:		% by vol.
Belladonnæ	flext. belladonna root 95, camphor	5.
Chloroformi..............	soap liniment 70, chloroform	30.
Saponis Mollis....	alcohol 30, lavender oil 2, soft soap	65.

By solution with heat:

Linimentum:		% by w't.
Camphoræ.	cotton-seed oil 80, camphor	20.
Terebinthinæ	resin cerate 65, turpentine oil	35.
		% by vol.
Saponis	camphor 4.5, soap	6.
	rosemary oil 1, alcohol 72.5, water, to	100.

By saponification:
Linimentum: % by vol.
Ammoniæ......cotton oil 57, oleic acid 3, alcol. 5, amm water 35.
Calcis..................linseed oil 50, lime solution 50.

PRODUCTS BY EXTRACTION.

The preparations made by extraction are represented by ten classes of which seven are liquid, one semi-solid, the Extracts; one solid, the Resins, and one semi-liquid, the Oleoresins.

With reference to the Menstrua, they are divided into **aqueous, acetous, vinous, alcoholic** and **ethereal** preparations.

The aqueous include the Mucilages, Infusions and Decoctions.

Mucilages—Mucilagines.

These are made by extracting the soluble principles of **mucilaginous** Drugs with Water.

When made from Gums completely soluble they may be classed as solutions. They are made by dissolving the substance in water and rejecting undissolved matter by straining.

Mucilago (gen.-inis): % by w't. or vol.
Acaciæ...........solution of lime 33, gum arabic 34.
Tragacanthæ, boiling water, glycerin 18. tragacanth 6.
Sassafras Medullæ ....sassafras pith 2.
By digestion:
Mucilago Ulmi................ slippery elm bark 6.

The two last-named should be freshly made when wanted.

Infusions—Infusa.

Unless otherwise directed to be prepared by the general formula:

Drug, coarsely comminuted, 5 Gm., Boiling Water to 100 c. c.

Pour the Boiling Water on the Drug in a suitable vessel, provided with a cover, and let it stand for half an hour in a warm place, strain with expression and add enough Water through the strainer to make 100 cc.

Caution.—The strength of Infusions of potent drugs, i. e., Ipecac, should be especially prescribed.

The following Infusions are official, being prepared by different strengths and by other processes than directed in the general formula:

Infusum:
Digitalis..................boiling water 50, digitalis 1.5
alcohol 10, cinnamon water 15, water to 100.
Sennæ Compositum..................fennel 2, Senna 6.
(Black Draught) boiling water 80, manna, magnes sulph ea............................ 12.

By Percolation with water without Heat to.........cc 100.
Infusum Pruni Virginianæ....glycerin 5., wild cherry 4.

Decoctions—Decocta.

Unless otherwise directed Decoctions are prepared according to the following general Formula:

Drug, coarsely comminuted....................Gm. 5.
Water to ....cc. 100.

Pour the Water on the Drug, contained in a suitable vessel provided with a cover, and let it boil for 15 minutes. Let it cool to 40°C. (104°F.), express, strain and add cold water through the strainer to make 100 cc.

Caution as with Infusions.

The following Decoctions were formerly official:

Decoctum: Cetrariæ; Sarsaparillæ Comp.

Vinegars—Aceta.

The Vinegars are made by extraction with Dilute Acetic Acid.

By maceration:

Acetum: in 100 cc.

Opii (Black Drop)........sugar 20, nutmeg 3, opium 10.
Scillæ .... squill 10.

The liquid extract of Squill is clarified through coagulation by boiling and filtration.

The vinegars of Lobelia and Sanguinaria (80) were of the same strength.

Wines—Vina.

The Wines are made by solution, or mixing, and by extraction by maceration. The Menstrua is White Wine to which from 5 to 17.5 per cent of Alcohol is added to aid in the extraction and in the preservation. There are ten Wines official.

Those made by solution:

Vinum: in 100 cc:

Antimonii........antimony, potass. tart. (sol. water) 0.4
Ferri Amarum.........iron, quinine citrate, soluble 5.
(Bitter Wine or Iron) tinct. orange peel 6, syrup 30.
Vinum Ferri (Citratis c90)......iron ammonium citrate 4.
tinct. orange peel 6, syrup 10.
Ipecacuanhæ .... (alcohol 10) flext. ipecac 10.
Vinum Opii (alc. 15), cinnamom, cloves, each 1, opium 10.

By maceration:

Vinum Cocae, (alcohol 7.5, sugar 6.5............flex. 6.5
Colchici Seminis (alcohol 15)..............flext. 10.
Vinum Ergotæ (alcohol 5)............flext. ergot 20.

The Natural Wines: Vinum Album and Vinum Rubrum are described under "Products of Fermentation."

Tinctures—Tincturæ.

The Tinctures are liquid preparations made by the extraction of Drugs with menstrua of Alcohol and Water in various proportions.

They are prepared by maceration and filtration; also by percolation and a few by solution:

By **maceration** and **filtration**, those containing resins and oleo-

Syllabus of the Official Tinctures.			Menstrua for 100 cc., or vol. %.		
	Alk.%	Part of Drug	Water	Alcohol	Glycerin
Containing 10 per cent.					
Tinctura Aconiti	0.045	root	30	70	
" Aloes, (glycyrrh 20)	......	extract	50	56	
" Cantharidis	......	insect	...	100	
" Capsici	.....	fruit	5	95	
" ~~Cardamomi~~	.....	fruit	50	50	
" ~~Chiratæ~~	......	herb	35	65	
" ~~Cinnamomi~~	......	bark	20	75	5.
" ~~Croci~~	....	stigma	50	50	
" ~~Kino~~	......	insp. juice	20	65	15.
" ~~Matico~~	......	leaves	50	50	
" Opii	1.2	insp. juice	50	50	
" Opii deodorati.....	1.2	"	80	20	
" Strophanthi	......	seed	35	65	
" ~~Sumbul~~	......	root	35	65	
" ~~Tolutana~~......	......	balsam	....	100	
" Vanillæ, Sugar 20...	.....	fruit	35	65	
Tinctura Belladonnæ Fol	0.035	leaves	50	50	
" Cannabis Indicæ ...	......	herb	....	100	
" Colchici Sem	0.05	seed	40	60	
" Digitalis	......	herb	50	50	
" Gelsemii	.....	rhiz.	35	65	
" Hyoscyami	0.007	leaves	50	50	
" Lobeliæ	......	herb	50	50	
" Nucis Vomicæ	0 1	seed	25	75	
" Physostigmatis	0.014	seed	....	100	
" Sanguinariæ, Ac.Acet.2	......	rhiz.	40	60	
" Scillæ	......	bulb	25	75	
" Stramonii	0.03	seed	50	50	
" Veratri	......	rhiz.	....	100	

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resins, Musk, and tinctures of fresh herbs; in a few instances with heat the Tinctures of Opium, and Quillaja.

By **percolation**, when prepared from dried vegetable drugs, i. e., barks, leaves, roots, etc., usually after brief maceration.

By **solution**, mixing a solution (chloride iron), or dissolving a solid in alcohol (iodine, ext. nux vomica).

Tinctures are the simplest form of alcoholic products by extraction.

From a Tincture all the other preparations may be **progressively** produced, through concentration by evaporation, as follows:

Fluid Extract representing a uniform drug-strength, viz., 1 Gram in 1 cc

Extract, either "solid extract," a semi-solid mass of pilular consistence of no uniform drug-strength; or **Powdered** Extract, made to represent a certain drug-strength, or alkaloidal strength by assay, and dilution with milk-sugar or other inert powder.

Resins, the resinous constituents obtained by precipitation in Water of a concentrated alcoholic Tincture.

The Tinctures range in strength (excluding the compound tinctures) from 5 to 50 per cent. They are all made **by volume.**

SYLLABUS OF TINCTURES (CONTINUED).			Menstrua for 100 Parts by vol.		
	Alk.%	Part of Plant or Drug	Water	Alcohol	
Containing 5 per cent.					
Tinctura Kino	..	insp. juice	20	65	
" Moschi	....	secretions	50	50	
Containing 20 per cent.—					
Tinctura Arnicæ (Flo '90)	......	flowers	50	50	
" Asafœtidæ	.....	gum-resin	....	100	
" Aurantii Amari	....	rind	40	60	
" Benzoini	.....	bals-resin	...	100	
" Calendulæ	...	herb	. .	100	
" Calumbæ	.....	root	40	60	
" Cardamomi	....	seed	50	50	
" Cimicifugæ	..	rhizome	.....	100	
" Cinchonæ	0.75	bark	25	67.5	Glyc 7 5
" Cinnamomi	.....	,,	25	67.5	7.5
" Gallæ	......	exc recs.	.....	90	Glyc. 10
" Guaiaci	.....	resin	.....	100	
" Guaiaci Ammon	....	"	......	....	sp.am.ar.
" Hydrastis	0.4	rhizome	35	65	
" Krameriæ	.....	root	50	50	
" Myrrhæ	......	gum-resin	.....	100	
" Pyrethri	.....	root	.. ..	100	
" Quassiæ	......	wood	35	65	
" Quillajæ	.....	bark	65	35	
" Rhei (cardam 4.)	....	root	40	50	10.
" Serpentariæ	.....	rhizo me	35	65	
" Tolutana	.....	bals	. . .	100	St.
" Valerianæ	.....	rhizome	25	75	
" Valerianæ Amm	.....	"	...	......	sp.am ar.
" Zingiberis	....	"	....	100	

Alcoholic Solutions of Inorganic Substances.

Tinctura Ferri Chloridi.—Sol ferric chloride 35 cc, alcohol 65 cc (anyhyd salt 13.28%). Av. Dose 0.5 cc.

Tinctura Iodi.—Potass iodide 5., iodine 7, alcohol to 100 cc. Av. Dose 0.1 cc.

Tinctura Nucis Vomicæ is prepared by dissolving 2 Gm. Extract Nux Vomica in the Menstruum to make 100 cc. The Tincture being one-tenth

the alkaloidal strength of the drug is in the 10 per cent group.

Tinctura Opii Deodorata.—The resinous constituents are removed by Purified Petroleum Benzin, the drug extracted with water and 20 per cent alcohol added.

Compouud tinctures (showing Gm. of drug in 100cc.		Water	Alco.	Glyc,
Tinctura:				
Aloes et Myrrhæ	aloes ... . 10. myrrh ... . 10. licorice root ... 10.	25	75	
Benzoini Comp....	aloes 2, benzoin 12. storax 8, tolu.. 4.	....	100	
Cardamomi Comp.....	cardamom ..... 2.5 cinnamom .... 2.5 car'y 1, 2, cochin'l 0.5	50	50	5
Cinchonæ Comp..... ..	red cinchona .. 10. bitter orange .. 8. serpentaria .... 2.	7.50	67.5	7.5
Gambir Comp...	gambir .... 5. cinnamon . .. 2.5	50	50	
Gentianæ Comp..... ..	gentian .... 10. bitter orange .. 4. cardam ... . 1.	40	40	
Ipecacuanhæ et Opii ...	tinct. opii deod. 100. fl. ext. ipecac... 10.	....	.....	ev. to 100
Lavandulæ Comp.. ...	oil lavend ..... 0.8 oil rosmar ..... 0.2 cinnamon ..... 2. nutmeg ... . 1. red saunders... 1. cloves 0.5	25	75	
Opii Camphorata	opium p...... .. 0.4 acid benzoic ... 0.4 camphor ... ... 0.4 oil anise 0.4	48	48	4
Rhei Aromatica	rhubarb .. .... 20. cinnam ... . 4. cloves .. .. 4. nutmeg .. .. 2.	40	50	10

Assayed Tinctures.—Eleven Tinctures are required to be of certain specified alkaloidal strengths and their classification according to their respective drug-strengths is therefore only approximate.

The percentages in the columns refer to the alkaloidal principles fixed by the assay processes of the U. S. Ph. as indicated in the Summary under Alkaloidal Drugs for the respective Tinctures.

Tincturæ Herbarum Recentium—Tinctures of Fresh Herbs, or "Green Tinctures."

When not otherwise directed, to be prepared by the following General Formula: the **Fresh Herb**, bruised or crushed, 50 Gm.

Macerate for 14 days in Alcohol 100 c.c.; express the liquid and filter.

According to this Formula the following two tinctures, to replace the respective Spirits are prepared:

Tinctura Aurantii Dulcis..fresh orange rind Gm., 50.,
Alcohol ....cc 100.

Tinctura Limonis Corticis..fresh lemon rind Gm. 50.,
Alcohol ....cc 100.

Tinctura Lactucarii, 50 per cent.—

To furnish a concentrated solution that will mix without precipitation with syrup the resinous constitutents of 50 Gm. Lactucarium are removed by Purified Petroleum Benzin and the drug thus purified is then extracted with a menstruum of water 20, alcohol 50, glycerin 25, dilute alcohol to cc. 100.

FLUIDEXTRACTS—FLUIDEXTRACTA.

Fluidextracts may be defined as a class of concentrated tinctures of such strength as to represent the drug **volume for weight**.

The fluidextracts of the U. S. Ph., previous to 1880, represented **one grain** of drug in **one minim**, or one troy ounce in one fluid ounce. In the U. S. Ph., 1880, the standard adopted was **one Gram** in **one cubic centimeter**, and this strength has since remained the standard.

Fluidextracts are made by **percolation, maceration** or **digestion** and **expression**. Except on a large scale, or by **fractional percolation,** they cannot be prepared by simple percolation without evaporation to concentrate the percolate to the required measure.

Fractional or repercolation, or simultaneous fractional percolation, by employment of which the use of heat for concentrating the percolate is avoided, may be used to advantage, when the quantity operated upon is sufficiently large to warrant the greater time and attention required.

The following are the processes employed:

A. In proceeding to percolate one hundred Grams of the drug, according to directions, (or as desccribed in Lecture III, pp. 86-87), the first 80 to 90 cubic centimeters percolate are reserved and set aside. The percolation is then continued until the exhaustion is completed and this weak percolate is evaporated to a soft extract (the alcohol being recovered) and dissolved in the reserved percolate. Sufficient of the menstruum is then added to make the product measure 100 c. c.

B. In some drugs, the active principles are extracted with difficulty or liable to dissociation by the heat employed in the evaporation of the weak percolate. In such cases an **acid** is added to the menstrua which combines with the **alkaloid** and forms **salts** much more soluble and not so readily volatilized.

To this class belong:

C. When the active principles are of **acid character** and extracted with difficulty by the use of ordinary solvents (neutral menstrua) or are liable to gelatinize, **alkaline** menstrua are employed for their extraction.

D. When the active principles are **readily soluble in water** and the drug is very cellular, extraction is effected by digestion and expression. This method must be applied only to drugs whose principles are not impaired by the heat necessary to concentrate the expressed liquid to the required measure.

Maceration and expression are preferable to percolation in exhausting a drug with water because the cell-walls swell, and the water acts upon starch and gummy matter, thus impeding the flow in percolation. A greater proportion of solvent is also necessary than in the process of percolation, hence the necessity for the evaporation of the liquid extract. Since water, especially when hot, extracts matter causing fermentation, the liquid is evaporated to about **four-fifths** the volume corresponding to the weight of the drug employed and Alcohol added so that the liquid may contain from 20 to 25 per cent of alcohol by which the undesirable principles are precipitated. The easily fermentable substances are insoluble in liquids containing 20 per cent, or above, of alcohol, and are precipitated and freed from the extract by filtration. The alcohol also acts as a **preservative**, since aqueous solutions of vegetable substances do not keep for any length of time.

Two of this class are official:

Extractum Castaneæ Fluidum............glycerin 10, leaves
"   Tritici Fluidum.......................rhizome

Extractum Ergotæ Purificatum or "liquid ergot," Ergotin, and Extractum Sennæ Fluid Aquosum may be prepared by this process.

Fluidextractum Glycyrrhizæ.—By the same process, except that the watery liquid extract is concentrated to about one-half the volume corresponding to the weight of the drug (45 c. c. from 100 Gm.); mixed with an equal volume of Alcohol, the liquid freed from precipitate by filtration, the Alcohol removed by distillation and the aqueous liquid mixed with 25 volumes Glycerin, 20 volumes Alcohol and Water to make 100 c. c. for 100 Gm. drug.

The official proportions for menstrua expressed in percentages by volume (cubic centimeters), are given in the subjoined tables:

MENSTRUA—ALCOHOL (94 PER CENT BY VOLUME.)

Fluidextractum.	Drug.	Fluidextractum.	Drug.
Aromaticum	aromatic powder.	Gelsemii	root.
Cannabis Ind	herb.	Lupulini	glands.
Capsici	fruit.	Sabinæ	tops.
Cimicifugæ	root.	Veratri	rhizome.
Cubebæ	berry.	Zingiberis	rhizome.

MENSTRUA—ALCOHOL 80; WATER 20, C.C.

Fluidextractum.	Drug.	Fluidextractum.	Drug.
*Belladonnæ Radicis	root.	Rhei	root.
Eriodictyi	herb.	Scopolæ	root.
Euonymi	bark.	Serpentariæ	rhizome.
Mezerii	bark.	Staphisagriæ	seed.
Podophylli	rhizome.		

MENSTRUA—ALCOHOL 75; WATER 25, C.C.

Fluidextractum.	Drug.	Fluidextractum.	Drug
*Aconiti	root.	Leptandræ	rhizome .
Calumbæ	root.	Matico	leaves.
Eucalypti	leaves.	Sumbul	root.
Grindeliæ	herb.	Valerianæ	rhizome.
Buchu	leaf.	Xanthoxyli	bark.
Calami	root.		
*Ipecacuanhæ	root.		

MENSTRUA—ALCOHOL 67; WATER 33, C.C.

Fluidextractum.	Drug.	Fluidextractum.	Drug.
Aurantii Amari	rind.	*Hyoscyami	leaf.
*Colchici Seminis	seed.	Viburni Opuli	bark.
Convallariæ	roots.	Viburni Prunifolii	bark.
		*Stramonii	seed.

MENSTRUA DILUTED ALCOHOL; ALCOHOL 50; WATER 50, C.C.

Fluidextractum.	Drugs.	Fluidextractum.	Drug.
Berberidis	bark.	Lappæ	root.
Chimaphilæ	herb.	*Pilocarpi	leaves.
Chiratæ	herb.	Phytolaccæ	root.
*Cocæ	leaf.	Quillajæ	bark.
Digitalis	leaf.	Rubi	bark.
Eupatorii	herb.	Scutellariæ	herb.
Gentianæ	root.	Sennæ	leaf.
*Guaranæ	seed.	Spigeliæ	root.
Krameriæ	root.	Stillingiæ	root.

MENSTRUA—ALCOHOL 40; WATER 60, C.C.

Fluidextractum Frangulæ....... bark. Rhamni Purshianæ.

MENSTRUA—ALCOHOL 33; WATER 67, C.C.

Fluid Extractum Quassiæ.....wood. Sarsaparillæ.......... root.

Menstrua—Alcohol, Water and Glycerin in various Proportions:

Fluidextractum.	Drug.	Alco.	Water	Glyc.
		Menstrua in 100 C.C.		
Apocyni	root	60	30	10
*Cinchonæ	bark	80	10	10
Geranii	root	60	30	10
Granati	bark	45	45	10
Hamamelidis	leaves	30	60	10
*Hydrastis	rhiz.	60	30	10
Pareiræ	root	60	30	10
Pruni Virginianæ	bark	20	60	20
Querci	bark	45	45	10
Rhois glabræ	fruit	45	45	10
Rosæ	leaf	45	45	10
Sarsaparillæ Comp.........Sarsaparill 75, glycyrrhiza 12, sassafras 10, mezereum 3		30	60	10
Uvæ Ursi	leaves	20	50	30

Fluidextractum.	Drug.	Alco.	Water.	Acid Acet.
		Menstrua in 100 C.C.		
*Conii	fruit	50	50	2
Ergotæ	sclerot	50	50	2
*Nucis Vomicæ	seed.	75	25	5
Sanguinariæ	rhiz.	75	25	5

Two of this class are official:

Fluidextractum.	Drug.	Alco.	Water	Amon. Water
		Menstrua in 100 C.C.		
Senegæ	root	75	20	5
Taraxaci	root	50	50	Sol. Potas. 5.

1. The Senna is first exhausted of its resinous constituents, then dried and exhausted with Diluted Alcohol.

With Magnesium Oxide and Water, drying and extraction:

With menstr: Alcohol 50, water 25, Glycerin 25cc.

Fluidextractum Rhamni Purshianæ Aromaticum.

With the addition of Glycyrrhiza 10; Comp. Spirit Orange 1.

Acètic Acid Fluidextracts—

Menstrua Acetic Acid 27.5 cc; water to 100 cc.

Fluidextractum Lobeliæ ....herb
Sanguinariæ..rhizome
Scillae ....bulb

EXTRACTS—EXTRACTA.

Extracts, or "solid" extracts as they are termed, to distinguish them from fluidextracts, are the soluble active principles of drugs, concentrated by evaporation to a soft solid, or a plastic **mass** of **pilular** consistence; or with or without addition of some inert powder (diluent) and reduced to **powder.**

The **strength** of an extract depends upon the amount of the crude drug it represents. Hence, the **smaller** the percentage of extract obtained from a drug, the **greater** the relative strength of the extract; provided that the drug is exhausted with menstrua adapted to secure all the active principles in this form.

Thus the extracts of different drugs are as many times stronger than the drug as the quotient obtained by dividing the drug at 100 by the percentage yield. For example: Podophyllum yields 10 per cent of extract; then $100 \div 10 = 10$, that is, the extract is ten times as strong as the drug and the Fluid Extract, or that 0.1 of the extract represents 1 Gm. of the Drug or 1 c. c. of the Fluid Extract.

The yield of extract is influenced by the character of the menstrua employed; with a few drugs like Rhubarb the quality of the drug sometimes governs the yield, the least percentage being obtained from the poorest quality.

As a general rule, the more **aqueous** the menstrua the **greater** the yield of extract; conversely, the more **alcoholic** the menstrua the **smaller** the yield of extract. To obtain the extracts, therefore, of official **strength** it is necessary to use official **menstrua** in the extraction. The strength of the extracts of the **alkaloidal** drugs is fixed by assay; in most instances the extract being brought to a certain percentage strength by the addition of a diluent.

The 28 official extracts may be divided into four classes:

1. Those made by extraction with Alcoholic menstrua, by percolation and concentration to pilular consistence.

2. Those made by evaporation from Fluidextract to pilular consistence.

3. By extraction with Water and addition of Acetic Acid or Ammonia Water.

4. Powdered Extracts, and those made by addition of powders to the extracts, including those made to represent a certain weight of the Drug, usually 1 to 4, and several Assayed extracts.

5. One Compound Extract, of Colocynth.

The drug and alkaloidal strength of these and their doses may be presented as follows:

THE OFFICIAL EXTRACTS.

EXTRACTUM	Method of Preparation	Alkaloid %	Parts Drug in 1 of Ex.	DOSE OF EXTRACT Gm.	DOSE OF EXTRACT grns.
Belladonnæ Foliorum	Menst. Alc. 67: Water 33	1.4	4	0.01	1-5
Cannabis Indicæ	Alc. 100	...	10	0.01	1-5
Taraxaci	Alc. 12.5: Water 87.5	...	4	1.	15
Digitalis	From Fluidextract	...	4	0.01	1-5
Hyoscyami	" "	0.3	4	0.065	1
Rhei	" "	...	4	0.25	4
Scopolæ	" "	2.	4	0.01	1-5
Stramonii	" "	1.4	4	0.01	1-5
Sumbul	" "	...	4	0.25	4
Ergotæ	Menst. 60% Alc.: pp. HCl	...	8	0.25	4
Colchici	" Acetic Acid, 35	...	4	0.065	1
Gentianæ	" Water	...	4	0.25	4
Glycyrrhizæ	" Amon Water; Glyc. 5	...	4	1.	15
Malti	" Water; fermentation	...	2	.....	....
EXTRACTUM (POWDERED)					
Cimicifugæ	From Fluidextract Dil. Glycyrrh.	...	4	0.25	4
Euonymi	" " " "	...	4	0.125	2
Leptandræ	" " " "	...	4	0.5	7 1-2
Rhamni Pursh	" " " "	...	4	0.25	4
Colocynthidis		...	5	0.03	1-2
Aloes	Water	...	2	0.125	2
Haematoxyli	"	...	4	1.	15
Krameriæ	"	...	5	0.5	7 1-2
Quassiæ	Water Dil. Lactose	...	10	0.065	1
Opii	Water Dil. Lactose	20.	1.6	0.03	1-2
Nucis Vomicæ	Acetic Acid Dil. Lactose	5.	5	0.015	1-4
Physostigmatis	Alcohol Dil. Glycyrrh.	2.	13	0.015	1-4

Colocynthidis Compositum—Mixture of Purif. Aloes 50, Ext. Colocynth 16. Scammony resin, soap powder, each 14; Cardamon 6.

To the Aloes, fused on a water-bath, the Alcohol is added, then the Soap, Colocynth Extract and Scammony Resin; the mixture is heated until it becomes brittle upon cooling; when the Cardamon is thoroughly incorporated and the mixture allowed to become cold, when it is reduced to powder.

OLEORESINS—OLEORESINÆ.

The **pharmaceutical** Oleoresins are semi-liquid extracts, obtained by exhausting Oleoreisinous drugs with Acetone or **Alcohol.**

The **natural** Oleoresins have been considered.

These solvents extract **fixed** and **volatile oils** from drugs, as well as **resin**; these principles constitute therefore the oleoresins which sometimes also contain other active matter in solution or suspension.

The solvent being easily volatilized, are recovered by distillation; they are sometimes superseded by alcohol, which yields an extract very similar.

The five official are all extracted with **Acetone**; Cubeb is extracted with **Alcohol.**

Oleoresina Aspidii separates into two layers, to be mixed when used.

Oleoresina Capsici—separates fat.
" Cubebæ— " wax.
" Lupulinæ
" Piperis—separates piperine, to be rejected.
" Zingiberis.

RESINS.—RESINÆ.

The official Resins may be divided into the (1) Natural Resins, (2) Resins obtained from Oleoresins by separating the Volatile Oil by distillation and (3) Pharmaceutical Resins, prepared by **precipitation.**

When a concentrated tincture of a resinous drug is poured into a large quantity of cold water the resinous matter becomes insoluble, and is precipitated; after being washed, dried and sometimes powdered, this is termed a **resin.**

Resins are usually **soluble** in Alkalies and **insoluble** in Acids (dilute); for this reason the Water used for precipitation is sometimes rendered slightly acid to favor the separation.

The three following are official:

Resina Jalapæ—precipitated in water; yield 8%, 1 rep. 12 of Drug.

Resina Scammonii—precipitated in water; yield 80%.

Resina Podophyli—precipitated in acidulated water; yield 5%.

The natural Resins and the Resins obtained as by-products in

the distillation of oils were considered under the Natural Oleo-resins.

The terms **resin, resinoid** and **concentration** are also applied to a class of preparations used by eclectic physicians, prepared by this general process with some modifications. (See U. S. and Am. Disp.)

They are named after their respective Drugs with the ending **in** as in the Glucosides and must not be confused with the latter. While the Glucosides are usually the active medicinal constituents representing the drug, the resinoids being only the **resinous** constituents represent the value of such drugs only, whose chief constituents are resins, or whose medicinal value depends upon resins.

MIXTURES OF SOLIDS.

This division embraces the several classes of preparations consisting of Mixtures of Solids in various **forms.**

As their therapeutic uses govern their pharmacal form, they may be divided into those (1) for **internal** use and those (2) for **external** use. The first group includes the Powders, Triturations, Confections, Troches, Masses and Pills.

These are presented according to the **progressive system,** illustrative of the methods by which the various preparations may successively be made from each other, i. e., from the lowest form, **powder,** to the highest, **pills.**

From a **powder** the other preparations may be made as follows:

Trituration, by trituration with a diluent as Sugar of Milk.

Confection, by making a mass from the powder with Sugar, etc.

Troches, by cutting a mass like a Confection containing gum and flavor into discs and drying them.

Mass, by forming the powder into a plastic mass with Excipients.

Pills, by forming the mass into spherical bodies not to exceed 0.3 in weight, intended to be swallowed.

POWDERS—PULVERES.

The nine official Powders are **impalpable** mixtures of one or more active drugs, usually with some nearly inert substance such as Sugar, as a **diluent,** and Aromatics.

They are made by trituration:

Pulvis—		Gm. in 100.
Acetanilidi Compositus	.............acetanilide	70.
	caffeine 10, Sodium bicarb	20.
Aromaticus	....cinnamon (Saigon), ginger, each	35.
	cardamon (seed), nutmeg, each	15.

Pulvis—

Cretæ Compositus	acacia p. 20, sugar 50, prep. chalk	30.	
Glycyrrhizæ Compositus	senna 18, glycyrrhiza r't	24.	
	fennel oil 0.4, washed sulphur 8, sugar	50.	
Ipecacuanhæ et Opii	..ipecac, opium pulv., each	10.	
(Dover's Powder)	sugar of milk	80.	
Jalapæ Compositus	...potass, bitartrate 65, jalap	35.	
Morphine Compositus	........morphine sulphate	1.5	
(Tulley's Powder)	glycyrrhiza, 33, camphor	32.	
	calc. carbonate precipe	33.5	
Rhei Compositus	.magnesia 65, ginger 10, rhubarb	25.	
		Gm. for	12 grs.
Effervescens Compositus	..potass, and sodium tart	93.	120
(Seidlitz Powder)	sodium bicarbonate	31.	40
	acid tartaric	27.	35

TRITURATION.—TRITURATIONES.

Impalpable mixtures of medicinal substances with Milk Sugar as a **diluent.**

Unless otherwise directed prepared as follows:

The Medicinal Substance 10; Sugar of Milk 90 parts.

The medicinal substance, in powder, is triturated with an equal weight of Milk Sugar till thoroughly mixed. The remainder of the Milk Sugar is added a little at the time, triturating after each addition until a perfectly impalpable powder is obtained.

There is one Trituration official:

Trituratio Elaterini—Elaterin Gm. 1. triturated with Milk Sugar, to make Gm. 10.

CONFECTION—CONFECTIONES.

Confections may be defined as flavored masses wherein the adhesive substance is Sugar, in large proportions, serving as a **vehicle** for masking the taste of the drug.

Confections, when made by beating a fresh drug, first reduced to pulp with sugar until of the proper consistence, are termed **conserves.** When made from powders or extracts they are called **electuaries.**

Only one representative of each class is official:

		Gm. in 100.
Confectio Rosæ	............strong rose water 16, red rose	8.
(Conserve of Rose)	sugar 64, honey	12.
Confectio Sennæ	..............oil coriander 0.5, senna	10.
(Electua Sennæ.)	cassia fistula 16, fig 12, tamarind	10.
	prune 7, sugar 55, water to	100.

For details of manipulation, see U. S. Ph.

MASSES—MASSÆ.

Masses are mixtures of drugs of plastic or **pilular** consistence. They are made: (1) by incorporating the drug with adhesive substances; (2) by chemical reaction and incorporation.

By the **first** process:

Massa Hydrargyri....glycyrrhiza 10, althæa 15, mercury 33.
(Blue Mass) glycerin 9, honey of rose 33.

By the second process:

Massa Ferri Carbonatis monohyd sod. carb. 46,
(Vallet's Mass) ferr. sulph. 100.
honey 38, sugar, 25, syrup to 100.

By double decomposition between the Ferrous Sulphate and Monohydrated Sodium Carbonate, **ferrous carbonate** is formed, which is incorporated with Honey and Sugar to prevent oxidation, and to render the mixture a plastic mass.

TROCHES—TROCHISCI.

Troches or **lozenges** are confections made into various forms and then dried.

The **vehicle** or excipient consists of powdered gum Tragacanth or Sugar with **flavoring**, in some cases orange flower water; in others, tolu, nutmeg, vanilla, etc.

The active ingredients are mixed with the diluent or vehicle and made into a plastic mass with the particular excipient, water, or syrup. The mass is rolled out to the requisite thickness and the disks formed by cutting through it with a **punch**, or troche-cutter. The troches are then dried by exposure.

The size and weight of the troche are regulated by the thickness of the mass and the diameter of the cutter.

The 9 official Troches vary in weight from Gm. 0.5 to 1.5:

Active Drug.

Gm. in 100 Troches. In Each Troche.

		Gm.in 100	In Each	Flavor.
Trochisci:				
Acidi Tannici		6.	0.06	orange flor.
Ammonii Chloridi		10.	0.1	tolu
	extract glycyrrhiza	20.	0.20	
Cubebæ	oleoresin	2.	0.02	tolu
	extract glycyrrhiza	25.	0.25	
	sassafras oil	1.	0.01	
Gambier		6.	0.06	orange flor.
Glycyrrhizæ	ext. glycyrrhiza	15.	0.15	anise
et Opii	powd. opium	0.5	mg 5	
Krameriæ	extract	6.	0.06	orange flor.
Potassii Chloratis		15.	0.15	
Santonini		3.	0.03	orange flor.
Sodii Bicarbonatis		18.	0.18	nutmeg.

Lozenges of peppermint, lemon, musk, vanilla and gaultheria may readily be prepared by saturating **sugar lozenges**, or disks, with the respective essences or tinctures and permitting the alcohol to volatilize.

PILLS—PILULÆ.

Pills are spherical, more or less soluble, masses of medicinal substances rendered **cohesive, plastic** and **firm** in consistence by the addition of some substance (usually inert), termed **excipient.**

The **kind** of excipient employed varies with the nature of the medicinal substance. As a general rule such substances are chosen as give to the mass, with the smallest proportion, the greatest **plasticity**, and also best preserve the spherical shape of the pills. The excipient must also, unless the contrary be directed for especial purposes, be indifferent in character to avoid change in the medicinal agents.

Soluble Substances are rendered adhesive by the action of solvents and require the addition of some liquid that will act dissolving—water, alcohol, glycerin, etc., according to their solubilities. Others require the addition of adhesive substances, such as Syrup, Mucilage, Glucose, Glycerite Starch or Tragacanth, etc.

Drugs adapted to the **pill-form** may be divided as follows:

(1) The official Masses, Extracts and Scaled Salts.

Masses and extracts, of pilular consistence, require no addition, but when hard, or in powder, **water** is incorporated to restore them to their original form.

(2) Vegetable powders, the dose of which does not exceed 0.3 (5 grs.).

With these **adhesive** excipients are indicated, such as **Syrup**, Mucilage, Glycerite Tragacanth and **Glucose**. The last mentioned answers the requirements better than most other substances. Confection of Rose and **Extracts** of Gentian, Glycyrrhiza and Taraxacum are also used, when their color is not objectionable.

(3) Salts not too deliquescent and Alkaloids.

Excipients for these must combine **adhesive** and **absorbent** qualities. They are first triturated with a dry powder, i. e., Althea, Glycyrrhiza or **Milk Sugar,** and then mixed with the adhesive substance, viz.: Glucose or Glycerite of Starch or Tragacanth.

No excipient should be used that will give to the mass a color different from that of the medicinal ingredients (the base).

(4) Volatile oils and oleoresins.

The quantity of these when dispensed in pills being comparatively large, it is necessary to add some light **absorbent** substance, such as Magnesia or Starch, to which is added the adhesive material such as **Soap**. The practice of adding **wax** or resin to oils is not to be recommended except as a last resort, since they tend to render the pill insoluble.

(5) Resins and gum-resins.

These form an adhesive mass by the addition of a little **Alcohol**, with which more bulky excipients, such as **Soap**, may be incorporated to preserve the shape of the pill.

(6) Salts of the Chinchona Alkaloids, quinine sulphate, etc.

These are often prescribed in pill-form in large doses, and it is therefore desirable to reduce their bulk. For this purpose **dilute** Sulphuric Acid or Tartaric Acid is added in small quantity, which acts dissolving upon the salt, thereby converting it into a mass. This mass is incorporated with a little Glycerite of Starch, otherwise it soon loses its plasticity, and must therefore be rolled into pills as soon as formed. Chinoidine acts the same way, although its bulk is not reduced.

(7) Substances easily decomposed by organic matter.

Potassium Permanganate and Silver Nitrate are quickly "**reduced**" when incorporated with the excipients usually employed.

These should be mixed with an **inorganic** diluent not affected by them, such as Kaolin, Pipe clay or Fuller's Earth and made into a mass with **Petrolatum**.

In **making** pills the following points are to be observed:

The substance, if a solid, must be reduced to a very **fine powder**, thoroughly mixed with a small quantity of the diluent or excipient; the remainder of the excipient is then incorporated.

The mass must be worked until it is perfectly **homogeneous** and of such consistence that it will scarcely adhere to the sides of the mortar, but form a **coherent** mass upon the pestle. A good pill mass is recognized by this quality, in which case the mortar employed will present an almost clean appearance when the mass is finished.

The **mortar** used for making pills should be a No. 2 or No. 3, with a bottom rather deep than flat; the **pestle** should not fit too closely, but its extreme end should be shaped somewhat differently from the shape of the bottom of the mortar.

In **rolling** the mass the cylinder must be of **uniform** diameter and even at the ends. When cut upon a pill machine, the cutter is placed lightly upon the cylindrical roll and moved to and fro with gradually increasing pressure, until the roll is divided and the pills formed. They may also be rounded with a slab, or lid from a wooden ointment box, or some similar device, termed a pill-finisher.

Dusting powder is used for rolling the mass (to prevent it from sticking, for which powd. Glycyrrhiza is the best); also for dusting upon the pills to keep them separated from each other and to retain their shape; for this purpose **Lycopodium** is used except for white pills, which should be rolled in and dusted with **Milk Sugar** or Starch.

In pills **coated** with Sugar or Gelatin, such excipient is frequently em-

ployed as will prevent the mass from acting upon the coating—staining the pill. The more soluble a pill the greater is the danger of discoloration of the coating, and although solubility should be the greatest desideratum, it is frequently sacrificed in coated pills for an elegant exterior. With some masses, staining of the coated pill cannot be avoided, no matter what excipient may be employed; in that event some insoluble substance, such as **Talc** or **Starch**, is spread upon the pills before the sugar coating is applied.

The following 14 Pills are official:

PILULÆ.	Gm. for 100	IN EACH. cg.	IN EACH. grains	Excipient.
Aloes............purif. aloes, soap, each	13	13	2	water
Aloes et Ferri.......aloes, ex. iron sulf., arom. p. ea.	7	7	1	conf. rose
Aloes et Mastiches...........purif. aloes	13	13	2	
(Dinner Pill) mastic	4	4	⅔	
red rose	3	3	½	dil. alc.
Aloes et Myrrhæ.............purif. aloes	13	13	2	
myrrh	6	6	1	
arom. powder	4	4	⅔	syrup
Asafœtidæ .... asafœtida	20	20	3	soap
Cathartic Comp...extract colocynth comp.	8	8	1⅓	
Mild mercurous chloride	6	6	1	
resin of jalap	2	2	⅓	
gamboge	1.5	1.5	¼	dil. alc.
Cathartic. Vegetabiles..ext. colocynth comp.	6	6	1	
exts. hyoscyam.	3	3	½	
resin jalap	2	2	⅓	
ext. leptandra, res. podophyll, each	1.5	1.5	¼	
oil peppermint	0 8	0.8	⅛	dil. alc.
Ferri Carbonatis.........ferrous sulphate	16	6	1	
(Blaud's) sugar 4, tragac., althea, each	8			
potass. carb.	1			glyc. water
Ferri Iodidi[1]................reduced iron	4			
iodine	5			
glycyrrh, sugar, each	4			
ext. glycyrrh., acacia, each	1			water
Laxativæ Comp. ....aloin	1.3	1.3	¼	
Strychnine	0.05	0.05	1/128	
Ex. Bellad. leaf	0.80	0.8	⅛	
ipecac	0 40	0.4	1/16	Syrup
Opii.................soap 2, opium pulv.	6.5	6.5	1	water
Phosphori[1] .... phosphori[2]	0.06	0.06	1/100	
acacia 3, althea	6			glyc. water
Podophylli, Belladonnæ et Capsici........				
res. podophyll	1.6	1.6		acacia
Ex. bellad. leaf	0.8	0.8		glycerin
Sugar milk 6.5, capsicum	3.2	3.2		syrup
Rhei Comp. ....rhubarb	13	13	2	
purified aloes	10	10	1½	
myrrh	6	6	1	
oil peppermint	0.5			water

[1]Coated with ethereal solution of Balsam Tolu.
[2]Phosphorus dissolved in Chloroform.

PREPARATIONS FOR EXTERNAL USE.

To this class belong Ointments, Cerates, Suppositories, Plasters, Cataplasms, and Papers. The Vehicle, sometimes incorrectly called the "base," of the three first mentioned consists of fatty substances; of Plasters either Lead Plaster, resins, oleoresins, or mixtures of these.

The preparations for external medication are classified according to their **consistence**, or melting point, because this determines their therapeutic uses as well as their respective pharmaceutical forms.

Ointments melt at the body temperature and therefore produce an emollient effect, or induce the **absorption** of the medicinal substance by the system.

Cerates have a higher melting point, due to Wax they contain; the medicinal agent is not absorbed and they are therefore used as **protective** and to produce **local** effects.

Suppositories have the same fusibility as cerates melting at the body temperature and are designed for application to the **orifices** of the body.

Plasters have a still higher fusibility; they do not melt but become **adhesive** by the body temperature and are intended to produce **local** effect and afford **mechanical support** to the parts affected.

The **fusibility** is likewise governed by the respective Vehicles employed.

OINTMENTS—UNGUENTA.

Ointments are mixtures of a fatty vehicle with which medicinal agents are incorporated, readily fusing at the body temperature 35° to 40°C. (95° to 104°F).

The **vehicles** used are: Benzoated Lard, Ointment, Suet, Lard and Wax or Spermaceti in different proportions, Olive Oil Petrolatum and Wool-Fat.

The medicinal ingredients must be minutely distributed through the vehicle in order that the ointment may not prove irritating and that the greatest possible surface be presented to the epidermis. For this reason the highest quality of an ointment (next to its proper melting point) is **smoothness.** In the preparation of ointments care must therefore be taken that the method employed be such as to yield **smooth** products.

The vehicle is either officially directed, or in extemporaneous preparations prescribed by the physician.

The 22 official Ointments are prepared: (1) by mechanical admixture, (2) by fusion, or (3) by chemical reaction.

(1) Mixing the medicinal substances with the fatty body in a mortar, or on a slab, is the process usually employed for solid substances, especially when insoluble in the fat. Powdered

Drugs, Acids, Alkaloids, Extracts and Salts (not attended by chemical union) are examples adapted to this process.

The following points must be observed:

The **solid** must be in a **very fine powder**; a small portion of the fat must first be intimately mixed with the powder and the remainder of the vehicle then thoroughly incorporated until a perfectly homogeneous mixture is obtained.

Extracts, especially when hard, are triturated to a **semi-liquid** by the addition of a small quantity of **Water** or **Diluted Alcohol**, then gradually incorporated with the fatty vehicle.

Solids soluble in Fats, such as Phenol, and its derivatives, should be triturated with the melted fat, and the mixture stirred until congealed.

Insoluble Powders: Oxides, Carbonates, etc., should also be triturated with the melted vehicle and strained while liquid through gauze.

Official ointments prepared by simple admixture are the following:

Unguentum—	Parts of Drug in 100.	Vehicle.
Acidi Tannici (glycerin 20)....	20	ointment
Belladonnæ (dil. alcohol 5) ext. belladon leaf	10	benz. lard 65; hyd. wool-fat 20
Gallæ, nut gall, pulv...........	20	ointment
Hydrargyri Dilutum mercury....	50	suet 23; lard 25; mercury oleate 2
Hydrargyri Dilutum—mercurial ointment	67	petrolatum
Hydrargyri Ammoniati	10	hyd. wool-fat 40; white petrolat. 50
Hydrargyri Oxidi Flavi (water 10)	10	hyd. wool-fat 40; petrolatum 40
Hydrargyri Oxidi Rubri (water 10)	10	hyd. wool-iat 40; petrolatum 40
Iodi (glycerin 12, potass iod. 4)	4	benz. lard
Iodoformi	10	lard
Phenolis "Carbolic acid"......	3	white petrolat.
Potassii Iodidi (potass. carb. 0.6; water 10)	12	benz. lard
Stramonii (dil. alc. 5) extract..	10	hyd. wool-fat 20; benz. lard 65
Sulphuris (washed)	15	benz. lard
Veratrinæ (almond oil 6)......	4	"
Zinci oxidi	20	"
Zinci Stearatis.....zinc stearate	50	white petrolat.

(2) Substances readily fusible should be **melted**, when prepared in the form of ointments, so that they may be more intimately mixed.

The substance having the **highest melting point**, i. e., wax or plaster, is first melted; to this is added the fat and when completely liquefied the mixture is strained and then stirred till it congeals.

Unguentum (Simple) ....benzoinated lard 80, white wax	20
Acidi Borici ....boric acid	10
paraffin 10, white petrolatum	80
Aquæ Rosæ ....spermaceti 12.5, white wax	12
(Cold Cream) ....expressed oil of almond	56
then incorporate, borax 0.5, stronger rose water	19
Chrysarobini...........................benz. lard 95, chrysarobin	6
digest for 20 minutes, then strain.	
Diachylon (Hebra's) ....lead plaster	50
oil lavender 1, olive oil	49
Picis Liquidæ ....yellow wax 15, lard 35, tar	50

(3) By **chemical reaction,** whereby the character of the medicinal substance, and also that of the vehicle, is changed.

The only ointment of this class official is that of mercuric nitrate, in which the mercury is acted upon by nitric acid, forming mercuric nitrate and the lard is oxidized by a portion of the acid, forming a new compound termed **elaidin.**

	Parts in 100.
Unguentum Hydrargyri Nitratis.....mercury 7, dissolve in nitric acid	10.5
incorporated with lard 76, previously treated with nitric acid	7

At a temperature 105° C and allowed to cool 40°C, avoiding contact with iron.

The Oleates, closely related therapeutically to the ointments, have already been considered.

CERATES—CERATA.

Cerates are mixtures of fats similar to the ointments, but of **firmer consistence,** because they contain **Wax or Resin,** having a higher melting point than lard, in greater proportion than do ointments. In their preparation the same rules are to be observed as for ointments.

The six official cerates are divided into two classes:

(1) Prepared by fusion or simple admixture:

Ceratum (Simple)...........White petrolatum 20, lard 50, white wax	30
Camphoræ...........white petrolat. 15, benz. lard 40, white wax	35
camphor liniment	10
Plumbi Subacetatis.....................solution lead subacetate	20
(Goulard's cerate) white petrolatum 38, camphor	2
paraffin, wool-fat, each	20
Resinæ Comp..........................yellow wax, rosin, each	22.5
(Deshler's Salve) turpentine 11.5, linseed oil 13.5, Suet	30
Resinæ...........................yellow wax 15, lard 50, res'n	35
(Basilicon) in cold weather " 12, " 53, "	35

(2) By maceration, and digestion: 32

Ceratum Cantharidis...............lig petrolat 15, canthar, pulv.	32
(Blistering cerate) mix and macerate for 48 hours, then add to lard	17
(previously fused) yellow wax, resin, each	18

The maceration and digestion renders the vesicating principle of the Cantharides soluble and the preparation more active.

SUPPOSITORIES—SUPPOSITORIA.

Suppositories may be defined as variously shaped **masses of medicated fat** or other Vehicle which melts quickly and uniformly when introduced in the orifices of the body.

The U. S. Ph. gives a General Formula for preparing suppositories and defines them as to the **weights** and **shapes**, corresponding to their several uses, for introduction in the respective orifices of the body:

Suppositories should correspond to the principal requirements for ointments, viz: Complete admixture of the medicinal agents.

Rectal, cone-shaped, should weigh 2 Gm.

Urethral pencil-shaped, should be either 7 Cm (2½ inch) or 14 cm (5 inch) in **length** and **weigh** 2 or 4 Gm respectively, if made of Glycerinated Gelatin.

Vaginal, globular, or oviform, should **weigh** about 10 Gm, if made of Glycerinated Gelatin.

The **Vehicles** used are: Theobroma Oil, Glycerinated Gelatin and Sodium Stearate. The first mentioned or C cao "Butter" is best adapted for **rectal** suppositories, Glycerinated Gelatin for **urethral** and **vaginal** use, while Sodium Stearate is contained in the Glycerin Suppositories.

Cacao Butter **(oleum theobromatis)** possesses the property of melting at the temperature of the human body, 35°C. (95°F.), and yet remaining firm at ordinary temperature. An adition of 10 to 15 per cent of spermaceti is recommended to raise the melting point in suppositories containing chloral and phenol.

The **method** of preparing suppositories consists in mixing the medicinal ingredient, if solid, first reduced to powder in a mortar, with a small quantity of the grated Oil; the remainder of the Oil previously melted and cooled to 35°C. is then gradually incorporated, thoroughly mixed, and the mixture, if possible, without further heating, poured in the moulds previously chilled.

The mass may also be rolled out on a tile, divided as in making pills, and the cones formed with the fingers. By **compression** in a **screw-press** "machine," suppositories may also be formed from the prepared mass.

With **Glycerinated Gelatin** the Medicinal agent, if liquid or soluble, is mixed with enough Glycerin to weigh one-half the total weight required for the mass; if insoluble, for example, iodoform, it is triturated with this amount of Glycerin. This mixture is then incorporated with an equal weight of melted Glycerinated Gelatin, and, when the mixture is completely liquefied on the water-bath, it is poured into suitable molds and allowed to set for several hours before being removed.

Suppositoria Glycerini—Made by reaction of monohydrated Sodium Carbonate 0.5, in Glycerin 30 Gm., with Stearic Acid 2 Gm. and heating until a solution of **sodium stearate** or soap is formed, which is poured into moulds to make ten Suppositories. Upon cooling, the mixture gelatinizes and the suppository is wrapped in tin foil.

Uses.—Upon introduction in the rectum the mass melts and the Glycerin, acting dissolving upon the fæces, produce evacuation.

PLASTERS—EMPLASTRA.

Plasters are mixtures of various fatty or resinous solids of such high melting point as to be pliable when cold, but rendered **adhesive** by the warmth of the body.

The **vehicles** of plasters are: Lead plaster; made adhesive by admixture with **Rubber.**

The **making** of Plasters does not differ materially from the process employed for ointments and cerates, since they are all prepared by melting the various substances, and incorporating the medicinal substances last. Care must be taken, however, that the heat be not continued too long, lest the product be impaired.

The **spreading** of plasters, though usually done on a large scale, may be easily effected by the spatula.

The official plasters comprise:

(1) Lead Plaster and Adhesive Plaster, and (2) the Medicated Plasters.

Emplastrum Plumbi....Soap, dried, 100, dissolved in hot water 350

(Diachylon) lead acetate, 60, dissolved in hot water.... 250

Filter the lead acetate Solution into the hot Soap solution, collect, wash the precipitate, dry it on a hot tile and form it in rolls.

		In 100.
Emplastrum Adhesivum........	melt together petrolatum, rubber, each	2
	incorporate with lead plaster	96
Emplastrum Saponis...........................	lead plaster 90, soap	10
From Adhesive Plaster the following are prepared:		
Emplastrum Belladonnæ......................	ext. belladonna leaves	30
	Adhesive plaster	70
Capsici........................	adhesive plaster, oleoresin capsicum	0.25
Opii.........................	Adhesive plaster, water 8; Ext. Opium	6
Emplastrum Hydrargyri.................	Mercury oleate 1; Mercury	30
	hydrous wool-fat 10, lead plaster	59

PAPERS—CHARTÆ.

There is only one paper official which is Paper coated with Mustard used similarly to spread Plasters:

Sinapis.....................oil-free black mustard, 4 Gm. for 60 sq. Cm.

The Mustard is freed from the fixed oil by extraction with Benzin and mixed with a solution of India-Rubber in equal volumes of Benzin and Carbon Disulphide and spread upon Paper.

POULTICES—CATAPLASMÆ.

Poultices are mixtures of substances made into a soft mass intended for external application.

The only one official, is a socalled **Clay-poultice,** prepared from Kaolin and Glycerin, with Antiseptic agents:

Cataplasma Kaolini..........................	boric acid 4.5, Kaolin	57.7
	Methyl Salicylate 0.2; thymol, ol. pp'mint, each	0.05
	incorporated, with...................... glycerin, to	100

DISPENSING.

With the subject of dispensing is intimately connected that of the **organization** of a pharmacy, the utensils, shelf-bottles, fixtures and its **arrangement** generally. An adequate description of these can not be given here, and the student is referred to the various works on pharmacy.

Apparatus, involving a knowledge of the principles governing their construction and employment in a pharmaceutical process, such as mortars, funnels, stills, condensers, etc., have already been described in connection with the respective operations.

A pharmacy should be organized from a dispensing standpoint, so as to combine in order of their importance:

(1) Identity and conveniences. (2) Preservation and cleanliness.

The term **identity** is here applied more especially to the arrangement of containers, with a view to prevent mistaking one substance for another; the dispensing of **poison** naturally comes under this division. The Nomenclature of the labels governs this to a great extent, and if it be perfect and all containers arranged in **alphabetic** order, the safest plan of preventing mistakes is secured to competent dispensers, while to those less advanced it is the only true or scientific method.

Many objections have been urged against this system, the most pertinent being that the alphabetic arrangement sometimes brings a potent remedy (heroicum, next to one possessing very mild properties, as for example, Tinctura Opii and Tinctura Opii Camphorata, etc. This objection, however, can not be sustained, because all poisons and potent remedies, though not always classed as poisonous (termed **heroica** in the Continental Pharmacopœias) should be kept in containers of a capacity adapted to the comparatively smaller quantity required for dispensing purposes.

To illustrate: Tinctura Opii, if included in the general arrangement at all, should be kept in a bottle not exceeding one pint capacity, while the container for Tinctura Opii Camphorata should hold at least two pints.

It has also been proposed that the old **Latin** names in some cases be substituted for the Pharmcopœial titles, as, for example, Sal Rochelle and Tartarus Emeticus, for their respective official chemical names. There are some good reasons for this, in that the official names of these two com-

pounds, on containers of nearly the same size, especially if the names be incorrectly abbreviated, may easily be mistaken for each other, viz.: Sod. Pot. Tart. and Ant. Pot. Tart. But the great difference in the respective **quantities** kept on hand of these and other similarly related substances will require their separation. The plan is, moreover, without justification, for the reason that it would perpetuate arbitrary synonyms without scientific warrant.

A strict adherence to the Pharmacopœial nomenclature, with a **faultless abbreviation** on all containers, will not only tend to guard against errors in dispensing, but is also desirable because of its great **convenience**. It enables those familiar with Pharmacopœial nomenclature to find at least official substances with ease in any pharmacy, and, while a correct system affords the beginner much instruction and information, a confused or inaccurate one will prove exceedingly inconvenient, annoying, and frequently be fraught with serious consequences. But, in order that fatal mistakes may be as far as possible prevented, all substances known as **poisonous** should be kept in separate compartments, preferably under lock and key.

The **isolation** of poisons seems to be the most practicable, as it is the safest method of all the plans proposed, for preventing mistakes of a fatal character. As an additional precaution the substances should be left in the **original containers**, as these usually are each characteristic as to size and proportions. Of the various devices designed for this purpose, there are containers of **colored glass**, painted black, covered with sand paper, or provided with odd stoppers with jagged edges to rouse the attention of the dispenser; none of these, it is believed, can be relied upon unless the poisons are also kept in a separate place.

A **Poison Case** designed by H. Biroth (See Proc. Am. Pharm. Assoc., 1884) combines the advantages of compactness and convenience and is well adapted for the keeping of poisons.

Upon the theory that mistakes frequently occur because of absent-mindedness on the part of the pharmacist, it has been proposed that all poisons be kept in a drawer, in which the containers are promiscuously thrown, thus requiring careful examinations of the label for such as may be wanted for use.

PRESERVATION.

The preservation of medicinal agents is a very important part of the pharmacist's duties. Many articles, while originally of good quality, under certain conditions, such as **exposure** to **light**, changes in **temperature**, etc., deteriorate and not infrequently spoil.

The attention to be observed in the preservation of crude drugs of vegetable origin has already been pointed out, and the requirements in this respect for chemical compounds are indicated in the official descriptions in the Pharmacopœia.

But a still more important, if not larger, class of substances are left for consideration, namely, the so-called **Galenic** preparations, and especially those of a liquid character. Among these, the weaker preparations (that is, solutions not saturated, such as tinctures, spirits, medicated waters, solutions, etc.), are, as a rule, preserved without much difficulty, although undue exposure should as far as possible be avoided. Essential and Fixed Oils and preparations of the latter, such as **Ointments** and **Cerates** and **Plasters,** should be kept in a **cold** and **dark** place, and be well protected from the **atmosphere,** in tightly stoppered containers.

In **saturated** solutions preservation is more difficult, especially with compound preparations containing various ingredients, as, for example, Elixirs and Fluid Extracts. In many of these, upon exposure to the slightest change in temperature, some constituent is thrown out of solution, giving to the preparation a cloudy appearance or precipitate, either of which is very undesirable. Such preparations should be kept at a **temperature as near as possible to that at which they were prepared.**

Syrups and Emulsions, owing to their consistence, rarely precipitate, but, since they do not usually contain alcohol, they are liable to ferment or othewise spoil, when exposed to warmth, and they should therefore be stored in a **cool** place.

The ordinary glass-stoppered bottles are not adapted to **syrups** because the caking of the syrup in the neck of the bottle will make the withdrawal of the stopper exceedingly difficult and sometimes at the danger of fracturing the container. To avoid this difficulty, so-called "syrup bottles" are sometimes used in which the stoppers rest loosely upon the enlarged neck of the bottle, inside of which the stopper proper is suspended without coming in contact with the sides. The objection to this form of container is, that the air is not excluded, and the syrup is therefore liable to spoil. The best kind of containers for syrups and all saccharine liquids are **ordinary bottles with corks** and written labels; these are more convenient, are easily cleaned and sterilized with boiling water, so that the syrup may be poured into them whilst hot, without defacing the label.

The **preservation** of Fluidextracts presents probably more difficulties than any other single class of preparations, for the reason that they are usually saturated solutions of organic substances or principles, which, upon the slightest exposure, and frequently without exposure, become insoluble, and are thrown out

of solution until heavy precipitates are formed. This precipitation often continues until a very large proportion of the extracted matter, which often represents the most valuable principles of the drug, is precipitated, and the preparation becomes more or less inert.

This precipitation is sometimes due to exposure to **changes in temperature,** but most frequently to the employment of **menstrua** not capable of holding the extracted matter in solution. Other causes, however, at present not fully known, also operate to induce this change, which is singular in that when it has commenced it continues to develop, and the precipitate can not be redissolved without largely increasing the quantity of liquid. To prevent precipitation these preparations should be kept at even temperature, preferably about 15°C., and care should be taken that the proper menstrua be employed in their manufacture. The containers should be ordinary bottles, preferably of **amber glass,** so as to exclude the actinic rays of sunlight, which appear to have a decomposing action upon preparations containing a large proportion of chlorophyll; they should also be provided with tight-fitting corks, so as to prevent **evaporation** of the alcohol. Different lots of fluid extracts of the same drugs should **never be mixed,** as the slightest change in the alcoholic strength of the menstrua in different specimens will induce precipitation.

The **preservation** of Solids, embracing also mixtures of solid substances in various forms, such as Cerates and Ointments, while not as difficult as with preparations in the liquid form, deserves considerable attention, because their preservation involves also, a feature very essential in the practice of pharmacy, namely, **cleanliness.**

With Extracts (solid) it is especially to be observed that they should be kept in a cool and dry place. Those made with aqueous menstrua, are liable to ferment, when they swell and exude around the cover of the jar, defacing the label and the furniture. Extracts made with alcoholic menstrua, by exposure to a warm temperature, become dry and hard, rendering their dispensing difficult. These undesirable tendencies of the extracts may, to some extent, be counteracted by the incorporation of five per cent of glycerin in the extract when prepared, but glycerin readily absorbs moisture, and its presence in extracts, which are also naturally hygroscopic, increases this quality, hence the necessity of storing extracts in a dry place.

These observations apply also to Powdered Extracts, Masses, Confections, Pills, and all various classes of preparation of mixture of solids.

With preparations of an **oleaginous** character the same general rule is applicable as to high temperature and moisture. Many Cerates and Ointments, however, are prone to become rancid with the best of precautions, and they should be prepared either in very small quantities only, or **extemporaneously.**

GENERAL DISPENSING.

The dispensing of liquids is done by **measure**—except with a few substances, such as acids, glycerin, ether, etc., when sold in considerable quantities or used for a specific purpose.

The measures in use are chiefly of **glass**, graduated either according to the U. S. fluid measure, the Metric system in cubic centimeters, or according to both upon opposite sides.

In dispensing a mixture of any character, the dispenser should ascertain, first of all, that **every article required** for its completion is on hand.

The practice, however, of taking down all containers at one time, which is sometimes done with this object in view, so as to place them within easy reach, is not to be recommended, for reasons explained under the compounding of prescriptions.

The next step is to provide the **bottle** or **container** with a good **cork**, which should fit accurately; the very best quality of corks will be found the cheapest in the end; nothing is so apt to displease a patron as to find a poor, worm-eaten or short-cut cork in a bottle.

In **measuring** a liquid into a "graduate" from a shelf-bottle, care should be observed that:

(1) The **measure** be held by grasping the base of it firmly between the thumb and the index finger of the left hand, bringing it up so as to be on a level with the eye.

(2) The **container** is taken down from the shelf, after the label has first been carefully read, with the right hand placed near the bottom.

(3) The **stopper** is then clasped between the free little finger of the left hand, extracted, and the contents poured into the measure with great exactness.

(4) The **remaining drop** upon the lip of the bottle is then, by a dexterous movement, wiped off on the stopper, the latter inserted, and the container placed back on the shelf, the label being scanned.

(5) The liquid having been poured in, the bottle is **carefully stoppered** with a cork, the top extending so that it may be easily extracted with the fingers, yet so secure that it will not be loosened.

(6) The **label** should be plain and printed in black ink, except those for poisons, which should be in **red** ink. When blank labels are used, the writing should be **bold** and **legible** without flourish.

Labels should, as far as practicable, contain such information as may be essential to an intelligent use of the article; for example, with **glycerin,** "that it be diluted with a little Rose Water before applying it to raw surfaces," or with **Castor** oil how the taste may be best masked, etc. With all potent remedies the labels should bear the **doses,** with some injunction that care be observed in its employment, at least when for internal use. **Poison-labels** should give the proper **antidotes.**

The **paste** should combine adhesiveness, cleanliness and cheapness; **Dextrin mucilage** possesses these qualities better than any made from acacia, tragacanth or flour. It is prepared by heating four ounces of Dextrin in eight ounces of Water and one ounce of Acetic Acid until it is dissolved; one ounce of alcohol may be added to preserve it. This mucilage is used for gumming postage stamps.

In **labeling** a bottle, the label should be affixed, if the proportions admit, so that the center of the label will be about three-fifths the distance from the bottom of the bottle. It must never be placed **across the seam** on round vials, but exactly between the two seams, and should always be perfectly horizontal.

DISPENSING OF SOLIDS.

The dispensing of solids, to be treated in this connection from a purely mechanical standpoint, requires no special observation, as it involves merely weighing and making packages.

"Wrapping packages," as it is called, though apparently a trivial performance, is one to which considerable importance is attached by expert pharmacists, and when carried to perfection becomes an art which even the public does not fail to appreciate. The exterior of packages, no less than of the dispenser himself, tends to influence a favorable impression of the skill of the pharmacist and promote personal confidence and esteem. This to the pharmacist is of incalculable value, and, as the extra outlay is slight, it is well worthy his consideration.

The **art** of wrapping a package artistically may easily be acquired by any one possessing adaptability and patience; but as success depends chiefly upon practice and experience, the subject can be treated here only by calling attention to a few general rules to be observed. These are:

(1) Suitable paper.

None with ragged edges should ever be used, except for heavy goods, when old wrapping paper may be employed.

(2) Paper of proper size.

An assortment of different sizes should invariably be kept on hand, in compartments under the counter, convenient to the scales.

(3) Properly folded.

The package to be so made, that the center of the double crease shall be exactly in the center of the package, the ends folded over so as to present

a perfectly square knife-edge, and so far that their ends meet. The package should be **plump** and nearly square, rather than flat and long. All articles can not be wrapped so as to conform to these general directions, but with most substances this method gives a package of **correct proportions** and **neat appearance.**

(4) Correctly labeled.

It is as necessary that packages of solid substances be labeled, as are bottles containing liquids, although, except in the case of poisons, it is usually neglected. The label should be placed immediately over the center of the double crease, and attached with the **smallest quantity of paste,** barely sufficient to prevent it from slipping off. This enables the purchaser to easily remove it and attach it to a container.

(5) Securely tied.

When the package is made, and while it is lying upon the counter right side up, the **twine** is laid over it along the double crease and then turned over with both hands, the twine being held in position during this operation. After the twine has been crossed in the center this operation is repeated transversely, and the twine then tied in a **bow knot at the side.** This operation can be performed very quickly, and at no time is it necessary to lift the package more than a few inches from the counter, while the exceedingly awkward habit of placing the twine between the teeth is avoided.

The following mixtures of Solids are unofficial:

Cataplasma.—Poultices—Ground substances such as Bran, Oatmeal, Flaxseed or Ulmus mixed with boiling water to make a pasty mass to be spread on cloth and applied hot. Mustard Poultice is made of ground Black Mustard or, if a milder effect is required, equal parts of Black and White Mustard mixed with tepid water. Clay-Poultice is official.

Cigarettes.—Mixtures of drugs in coarse powder, such as Eucalyptus, Eriodictyon with clover blossom, etc., adapted to smoking for the relief of Catarrh, etc.

Species.—Teas—Mixtures of various drugs contused or coarsely comminuted for decoctions or infusions.

SOLUTIONS AND MIXTURES:

Collyria.—Eye Washes—Weak aqueous solutions for dropping or instilling in the eye.

Gargarisma.—Gargles—Solutions or aqueous mixtures of salts or astringent drugs for gargling.

Haustus.—Draught—A term applied to a liquid medicine usually to be swallowed at one "draught."

Injectiones.—Injections—Aqueous solutions of about 1 per cent strength for injecting in the urethra or vagina or for introduction under the skin—**subcutaneous**—with the hypodermic syringe.

Inhalationes.—Inhalations—Volatile liquids adapted to inhalation of vapors.

Lotiones.—Lotions—Washes, antiseptic, aqueous mixtures containing insoluble substances or solutions of antiseptic agents.

Nebulæ.—Sprays—Solutions sprayed in the body orifices by an atomizer.

Enemata.—Enemas or Clysters—Aqueous mixtures for injection in the rectum to evacuate the bowels or to serve as nourishment.

PRESCRIPTIONS.

Prescription is literally a written order for something—from **præ**, for, and **Scribo**, I write. Its popular use, however, relates to medicines, usually meaning a written order for medicines, though it is frequently employed to designate the remedy or mixture itself.

In **reading** prescriptions the most important considerations are:

(1) The language and abbreviations.

(2) The signs and terms.

The **language** of prescription-writing is primarily Latin, because the pharmacopœial titles are chiefly used in designating remedies. In other features, however, such as directions to be written on the label, Latin is rarely employed in America, and, when used, is usually its own condemnation.

LATIN IN PHARMACY.

A Nomenclature that can be understood by pharmacists of all civilized nations is as important to the profession of pharmacy as is a nomenclature of animals and plants to the zoologist and botanist.

Because it is a language with which most scholars are familiar, because of its flexibility, and from the fact that it is employed in prescription writing, Latin has by common consent been adopted in the naming of drugs and pharmaceutical preparations.

An elementary knowledge of the language is, therefore, of considerable importance to the pharmacist. We cannot, of course, undertake here to give the student a course in Latin. Those who have not had the advantage of attending schools where Latin is taught, should become familiar with the rudiments of the language by studying Wall's Lessons in Latin, or some similar work especially adapted to pharmaceutical students.

To illustrate the use of Latin in prescription writing, the following example is given:

℞ Acid. Arsenos ....gr. j
Ferri Pyrophos ....ʒ ss
Res. Podophyl ....gr. v.....
M. S. A. ft. Mas. et div. in pil. xx.
S. Una pil. detur bis in die.

Unabbreviated the same prescription would read as follows:

Recipe: Acidi Arsenosi granum unum, Ferri Pyrophosphatis

drachmam semis, et Resinae Podophylli grana quinque. Misce secundem artem, fiat massa, et divide in pilulas viginti.

Signa: Una pilula detur bis in die.

Literally translated it reads as follows: Take thou of Acid Arsenous grain one, of Iron Pyrophosphate, dram a half, and of Resin of Podophyllum grains five. Mix according to art, let be made a mass, and divide into pills twenty.

Write: One pill let be given twice in a day.

Or, putting the translation in the proper English order, the prescription will read:

Take of Arsenous Acid a grain, of Iron Pyrophosphate half a dram, and of Resin of Podophyllum five grains.

Mix according to art, let a mass be made, and divide into twenty pills.

Write: Let one pill be given twice a day.

ANALYSIS.

Recipe is a verb in the active voice, imperative mode, present tense, second person, and singular number; agreeing with **tu** (thou) understood.

Acidi is a neuter noun of the second declension, in the singular number and genitive case.

Arsenosi is an adjective agreeing with its noun, **acidi**, in gender and number and case.

Granum is a noun of the second declension, neuter gender, singular number and accusative case, the direct object of the word **Recipe**.

Unum is a numeral adjective, agreeing with its noun granum in gender and number and case.

Ferri is a neuter noun of the second declension, in the singular number and genitive case.

Pyrophosphatis is a masculine noun of the third declension in the singular number and genitive case.

Drachmam is a feminine noun of the first declension in the singular number and accusative case, and governed like **granum**.

Semis is a numeral adjective agreeing with its noun drachmam in gender, number and case.

Et is the conjunction **and**, connecting the preceding two clauses to the one following.

Resinæ is a feminine noun of the first declension, in the singular number and genitive case.

Podophylli is a neuter noun of the second declension in the singular number and genitive case.

Grana is a neuter noun of the second declension found in the plural number and accusative case.

Quinque is a numeral adjective qualifying grana.

Misce is a verb (from misceo) in the active voice, imperative mode, present tense, second person, singular number, agreeing with **tu** (thou) understood.

Secundem is a preposition governing.

Artem, which is a noun of the third declension, singular number, feminine gender and accusative case.

Fiat is a verb (from fio) in the active voice (in form though not in meaning), subjunctive mode, present tense, third person, singular number, agreeing with its subject, massa.

Massa is a feminine noun of the first declension, singular number and nominative case, the subject of **fiat.**

Et is a conjunction connecting **misce** and **divide.**

Divide is a verb (from divideo) in the active voice, imperative mode, present tense, second person, singular number, agreeing with **tu** understood.

In is a preposition governing pilulas.

Pilulas is a feminine noun of the first declension in the plural number, accusative case and governed by **in.**

Viginti is a numeral adjective qualifying pilulas.

Signa is a verb (from signo) in the active voice, imperative mode, present tense, second person, singular number, and agrees with its subject **tu** understood.

Una is a numeral adjective, feminine gender, singular number, and nominative case, qualifying pilula.

Pilula is a feminine noun of the first declension in the singular number and nominative case, the subject of the verb **detur.**

Detur is a verb (from do) passive voice, subjective mode, present tense, third person, singular number, and agrees with its subject, **pilula.**

Bis is an adverb modifying **detur.**

In is a preposition governing **die.**

Die is a noun of the fifth declension, masculine (or feminine) gender, third person, singular number and ablative case, governed by the preposition **in.**

THE PRESCRIPTION.

A prescription may be divided into five parts, as follows:

(1) The superscription= ℞. For................

(2) The inscription, i. e.: Tincturæ Opii ....ʒ i
Syrupi .. ..℥ i
Aquæ Cinnamomi ....℥ i

(3) The subscription, i. e.: Misce.

(4) The signa, i. e.: Sig. One teaspoonful every hour.

(5) The name of the prescriber and the date.

(1) The **superscription** consists of the mark ℞ (an abbreviation of the imperative of the verb recipio—**recipe,** which means "take thou,") and the **Name** of the patient. The latter is too frequently omitted. A perfect prescription should always bear the name of the person whom the medicine is intended for, and if for an **infant** it should be so designated.

(2) The **inscription** is the most important part of the prescrip-

tion, because it embraces the names of the different **ingredients** and their **quantities**, which are written in the genitive:

℞ Quininæ sulphatis—Take **of** quinine sulphate.

The rule is, therefore, that every word in the inscription must terminate in the **genitive.**

They are rarely written out in full, however, but are usually abbreviated. In the case of words having the first, or the first and second, syllables the same, as, for example, Hydrargyrum and Hydrastis, the abbreviation must not be carried so far as to involve doubt as to what substance is really wanted. To illustrate, the articles named are often abbreviated Hydr., which may mean either of them, or, when followed with chlor., would mean Hydrated Chloral, but might also be mistaken for Hydrargyrum Chloridum; both Calomel and Mercuric Chloride (corrosive sublimate) being improperly, though not infrequently, so written. In such cases the pharmacist should determine what article is intended by computing the dose and from a consideration of the other ingredients.

In compounds or mixtures the ingredients may be classified from the standpoint of prescribing into:

(a) The base or active constituents, the **basis.** This term is frequently but incorrectly applied to the substances employed to give form to the medicinal agents. The basis of the prescription must be the **active** constituent, both pharmaceutically and therapeutically considered.

(b) The forming substance. This is variously termed according to the form or consistence of the mixture: For liquids and ointments—**vehicle,** i. e., syrup and petrolatum respectively; in the form of powder—**diluent,** i. e., milk sugar, and when in a mass, as in the form of pills or troches—**excipient.**

(c) The **corrective** is applied to any agent which modifies the action of the active ingredient, as, for example, syrup of ginger in mixtures, or capsicum in purgative pills.

(d) **Adjuvant** is a term given to ingredients which may be added to increase the action of the base, but since these frequently are quite potent, the distinction is rarely made, and not here considered. These divisions are illustrated as follows:

Form	Base	Vehicle	Diluent	Excipient	Corrective
Liquid......	Potassii iodidi......	Aquæ. Syrupi...	....	....	Tinct. Zingiber
Powder.... .	Hydrargyri chloridi mite.....	....	Sacchari lactis....		
Pill........	Hydrargyri chloridi corrosivi..	....	Pulvis althaeæ..	Glycerit amyli,...	
Ointment...	Zinci oxidi	Adipis benzoin.			

(3) The **subscription** consists of signs or terms conveying directions as to the **compounding** and dispensing. When only one substance is prescribed, it is usually omitted; in the case of mixtures of liquids or solutions, the mark M, or **misce** (mix), is generally affixed.

The most common terms employed are, abbreviated.

M. ft. sol.	mix and make a solution.
M. ft. colat.	mix and strain the liquid.
M. ft. pulv.	mix and make a powder.
in Chart. divide	divide in papers (No.—).
M. ft. mass. pil. div.	make a mass, divide in pills.
M. ft. ung.	mix and make an ointment.

In case no especial directions are given, the pharmacist must employ his skill in compounding the mixture, that not only will the full medicinal effects be derived, but when possible also, that it be presented in the most agreeable and palatable form, expressed in the term **secundem artem.**

(4) The **signa** or the **directions** to be written on the label and affixed to the package or container. These are usually written in English, though sometimes, especially by English physicians, in Latin. There is no good reason for writing the directions other than in English, and in a **plain, bold** hand-writing. No secrecy is here necessary, as is sometimes desirable in the inscription. On the other hand, it may serve as a check on any errors in the label incident to dispensing. Abbreviated terms should be carefully scrutinized when employed, before writing the label, and the stereotyped expression, "Use as directed," should as far as possible be avoided on medicines for **internal** use. Many serious consequences might have been averted if concise directions were given.

The following Latin terms, more or less abbreviated, are used in the directions:

Latin.	**Abbrev.**	**English:**
Bis in die.	Bis in d.	Twice a day.
Capiat.	Cap.	Let him (or her) take.
Cochleare.	Coch., Cochl.	A spoonful.
Cochleare magnum.	Coch. mag.	Tablespoonful.
Cochleare medium.	Coch. med.	Dessertspoonful.
Cochleare parvum.	Coch. parv.	Teaspoonful.
Da, detur.	D., det.	Give, let be given.
Dentur tales doses.	Dent. tal. dos.	Give of such doses.
Diebus alternis.	Dieb. alt.	Every other day.
Diebus tertiis.	Dieb. tert.	Every third day.
Dimidius.	Dim.	One-half.
Donec.		Until.
Durante dolore.		While the pain lasts.
Harum pilularum summantur tres.	Har. pil. sum. iii.	Let three of these pills be taken.
Hora.	H.	An hour.

Latin.	Abbrev.	English.
Hora somni.	H. S., Hor. Som.	Before retiring.
In dies.	In d.	From day to day.
Inter.	Int.	Between.
Magnus.	Mag.	Large.
Mane. mane primo.		In the morning.
Modo præscripto.	Mod. præscript.	In the manner prescribed.
More dictu.	More dict.	In the manner directed.
Ne tradas sine nummo.	Ne. tr. S. num.	Do not deliver unless paid.
Nox, noctis.		Night.
Numerus.	No.	Number.
Omni hora.	Omn. hor.	Every hour.
Omni bihorio.	Omn. bihor.	Every two hours.
Omni quadrantehoræ.	Omn. quadr. hor.	Every quarter of an hour.
Omni mane.		Every morning.
Omni nocte.		Every night.
Primus.		The first.
Pro re nata.	P. r. n.	Occasionally.
Quantum libet placet, vis., volueris.	Q. l., Q. p., Q. v.	As much as you please.
Quaqua, quaque.	Q. Q.	Each or every.
Semis.	Ss.	A half.
Septimana.		A week.
Sesquihora.		An hour and a half.
Statim.	Stat.	Immediately.
Ter.		Three times.
Ter in die, ter die.	T. i. d., t. d.	Three times a day.
Ut dictum.	Ut dict.	As directed.
Utendum.	Utend.	To be used.

(5) The **name of the prescriber** and the **date** are frequently omitted, or at best, the former is given in initials only.

Since pharmacists are usually enabled to identify the prescriber by the hand-writing, the initials often suffice, especially since blanks with printed name, address and office hours are to a great extent employed. A much safer plan, however, is to write the name in full, so that errors may be avoided in writing the label.

The **date** should be affixed at the time of compounding by the pharmacist, so that its omission is of little importance.

Signs or **symbols** are used to designate quantities, and therefore belong to the inscription, but are more conveniently treated separately.

Of those used for designating Apothecaries' weights, the "scruple" and "pound" are going rapidly out of use. For liquids the signs represent only U. S. fluid measures, excepting the "drop," **gutta**, plur. **guttæ**, abbreviated "gtt.," which is too indefinite to warrant employment, and should be discarded in favor of the **minim**. These have already been fully described.

The **quantities**, except metric, are expressed in Roman numerals:

The numerals i—one; v—five; x—ten; l—fifty; C—one hundred; D—five hundred and M—one thousand, are the basis upon which this system is constructed. It has a symbol for each decimal unit; also one for

its first aliquot division, or five times the lowest preceding one as shown above. From these the intervening numbers are constructed by placing the different numerals side by side: i=1; v=5; x=10; vi=6; xv=15; xvi=16; xx=20; xxvi=26.

No numeral is used in sequence, however, more than three times, below one hundred; a higher number is constructed by placing the next lowest units **after** the lower one, for example: iv=4; ix=9; xl=40; XC=90. Very cautious prescribers, it may be added, frequently use the full word in preference to any abbreviation.

The terms and abbreviations in **metric** prescription writing were treated under the Metric Weights and Measures in Lecture I.

Signs for designating the quantity of the finished mixture are sometimes affixed to the last ingredient; the most important being:

Ad, the preposition "to"; ad ℥ iv=to (measure) four fluid ounces. **Quantum sufficiat,** or quantum satis, usually abbreviated Q. S. or q. s.—as much as is sufficient. Of these q. s. should always be preferred, since **ad** is susceptible of confusion with the abbreviations of the verb **adde,** "to add," which refers to the amount indicated for the particular article only.

Ana, abbreviated **aa,** of each, is appended when the same quantities are required of two or more ingredients; it follows the last of these preceding the quantity.

Dentur tales Doses no.—Let there be given of such doses number—, is a phrase used to designate the number of powders, pills or other Dosage Forms, **each** containing the quantities directed in the inscription.

Sic, Statem or the exclamation sign (!) after the quantity, indicates that the dose is exceptionally large, but that the prescriber is aware of this fact and directs the stated quantity for special reasons.

The more general adoption of signs like these would be very desirable, as their presence is exceedingly reassuring to the dispenser, when potent remedies are prescribed considerably in excess of the **average** Dosage of the U. S. Ph. The most effective method is to **underscore** the quantity.

THE COMPOUNDING OF PRESCRIPTIONS.

The compounding of prescriptions is the most responsible duty of the pharmacist. It is also the most difficult to fulfill properly, because it involves not only professional skill, but also mature

Probably no other division of human labor makes demands

simultaneously upon the exercise of so many faculties as are required of the pharmacist in the compounding of prescriptions. The greatest care, accuracy and skill may be displayed in compounding a mixture, when, in a moment of absent-mindedness, an error may be committed in writing the directions on the label, or placing the wrong label on the package, or, what is worse still, by delivering medicine intended for an adult in place of that for an infant.

All these points must be considered in the compounding of prescriptions, and they call for constant vigilance on the part of the pharmacist. Upon receiving a prescription it should be registered as a sacred trust, that the health and perhaps the life of his patron is in his care, and that this obligation is not discharged until he sees the little package, in which a fond mother's loving hope may be involved, safely in the hands of the proper person. Greater responsibilities may exist in other professions or vocations, involving the care of a greater number of lives and property, as in the operation of means of transportation, but errors or accidents may there usually be avoided by attention to well-known rules, disciplines, etc., or dependence chiefly upon mechanical means. In the dispensing of prescriptions, skill, rules and regulations are of little avail unless accompanied with a free mind, a clear head and an acute perception of the apparently most trivial details. In this branch of pharmacy **the price of safety is preeminently eternal vigilance!**

A general **plan of procedure** for compounding a prescription is here outlined in the belief that adherence to it will reduce the chances of error to a minimum, if not entirely exclude them.

IN RECEIVING THE PRESCRIPTION.

1. **Identity of Patron.**—Note carefully the person who brings the prescription, while he is politely invited to be seated.

(2). **Preliminary Survey.**—Glance over the prescription (or prescriptions) so as to determine, approximately, the length of time required to complete them.

(3). **Discreet Inquiry.**—Inquire whether or not it is desired to wait, to have it delivered, or to call for the prescription.

(4). **Memoranda.**—Make a memorandum accordingly, and in case it is to be delivered, or called for, note the name and address, unless numbered checks are used.

To prevent confusion the only **safe** method in the delivery of prescription medicines is to mark the **name of the patient** on the prescription. Numbered checks may become lost or exchanged by children when several are waiting. While sometimes the name is not readily learned, still it is the only certain plan by which mistakes in delivery may be entirely prevented.

(5). **Study.**—Read the prescription closely and deliberately,

especially the inscription, making meanwhile a mental inventory if the different articles are in stock and in the quantities required. In case of doubt examine the container, **but leave it in its place until wanted.**

(6). **Container.**—Select the container of proper size and place it upon the prescription as a **weight.**

If a **bottle,** fit it with a **long, soft cork,** squeezed with a press when necessary until it admits being inserted one-half its length; the other half extending facilitates its extraction with the fingers. The reprehensible practice of chewing the cork should, of course, not be tolerated.

(7). **Utensils.**—Procure all the **implements** necessary for the operation, spatula, mortar, graduate, etc., and place them within convenient reach, having previously made sure that they are **clean.**

(8). **Compounding.**—Procure the **first article** desired and weigh or measure it carefully.

If the inscription is correctly written upon the prescription, the **basis** or active constituents come first, and, if it consists of several, the most active ingredient is first taken, this being, in any event, the rule. The desired quantity having been disposed of, the container is stoppered, the **name on the label read,** deliberately, and then placed upon the desk at **one side of the scale;** the next article in order of **quantity** or **compatibility** is then procured; the label first being carefully read, the required quantity is obtained, and the **container disposed of** in the same way as the first and placed by it.

This process is continued until all the articles have been procured and the operation is finished. With very bulky preparations, it is sometimes inconvenient to place the containers on the counter, and this may perhaps be dispensed with.

WHEN THE PREPARATION IS FINISHED.

(9). **Checking.**—Each ingredient and quantity should be **checked** by the compounder or assistant on the prescription from the containers left standing upon the counter.

These should then be **immediately** put back in their respective places. This operation may be accelerated by the aid of an assistant. But no move must be made by the dispenser with any other work until the package is labeled, in order that **mistakes in labeling may be avoided.**

(10). **Memoranda.**—Any **additions and alterations** made in compounding should be explicitly stated upon the prescription, so that in case of renewal, the preparation shall be identical with that originally dispensed.

The **kind** and **quantity** of the various agents employed pharmaceutically, such as **Excipients** for pill-masses, or **Emulsifying agents,** are not infrequently ignored by the physician, who leaves their selection to the phar-

macist. For pharmaceutical reasons it may be necessary to deviate from the formula, in the character or quantity of the **Solvent,** or to make alterations in the **Vehicle, Excipient or Diluent,** entailing no objections therapeutically. This must never be attempted, however, except when absolutely necessary, and when possible, only with the consent of the prescriber and **should always be accompanied by the proper memoranda** affixed to the prescription.

(11). **Numbering.**—The **numbering** and **dating** of the prescription is next in order. Both should be written in a plain, bold handwriting.

To avoid duplication, or errors in numbering, various devices are employed, the most satisfactory being the "patent dating stamp," to be had with duplicate numbers as high as six figures, at reasonable cost. An inexpensive device may be constructed by writing consecutive numbers upon long strips of paper, one-half inch wide; by pasting these together a thousand or more numbers may be rolled upon a spool in a box, the numbered end extending through a slit in the side. When a prescription is to be numbered, a number is cut off the slip and copied on the prescription, or if gummed it may be attached to it, thus saving writing and insuring consecutive numbers, provided, of course, that the numbers on the slips have been written correctly, and also that this operation is always performed when a prescription is to be numbered.

(12). **Writing.**—Writing the **label** should be done, as in all writing pertaining to pharmaceutical work, clearly and distinctly, without flourish or abbreviation.

In writing the directions the **numbers** should always be written in **words** as well as given **in numerals**; for example:

Two (2) teaspoonfuls every three (3) hours.

This lessens the chance for error by the patient.

The **name** should be appended whenever it can be learned.

The **date** must always be given, as through it a prescription can frequently be found when desired for repetition, when the number on the label has been effaced. In the absence of a generally accepted plan, the number of the month should be given in Roman, the date in Arabic; thus X, 13, 1906.

The **physician's name** should always be written in full.

DISPENSING.

(13). **Labeling.**—Labeling must be done **immediately** upon the finishing of each mixture or compound, and as soon as the label is written.

When two or more prescriptions are received for compounding, each mixture should be so completed as to make it impossible to mistake it for another. This can only be done by affixing the label to each, before work is commenced on the next one. In case two liquids are prepared for **internal** and **external** use respectively, care must be observed that the labels are not interchanged on the bottles, since mixtures intended for external application usually possess dangerous properties when taken internally.

The following **strip labels** should always be used when directed upon the prescription; and when therein omitted, though clearly indicated, should be employed with proper discretion:

For External Use. Shake Well Before Using.

The injunction, "for external use," to the public conveys the impression that the mixture must be used only outwardly on the body, and that it does not apply to **eye-washes, gargles, injections,** etc. While this interpretation is incorrect, it is best to avoid confusion by the employment upon these of the label, "Not to be taken!"

These strip labels should be attached **above** the label proper, as they are then more conspicuous than when appearing below it. If more than one is used on the same bottle, they may be placed alternately, the most important occupying the most conspicuous position.

(14). **Packing.**—The wrapping of the package should be neatly done, after which it may be either tied with **twine,** or preferably, the ends fastened together with **red sealing-wax**; black wax should never be used, owing to the superstition of some persons construing its employment as an evil omen.

This is also true in **sealing** the cork tops, which is now chiefly done with the gummed tops in various bright colors. **Capping** the bottle with a piece of glazed paper is an exceedingly attractive manner of finishing the package, and is especially to be commended as it assures the patient that the **contents are intact,** when procured through the aid of a messenger. This is a feature practiced generally on the Continent, and worthy of adoption here.

(15). **Delivery.**—In delivering the package, care must be observed that no mistake be made in the **identity** of the medicine or of the patron.

In case numbered checks are not used, the **name** should be ascertained by diplomatic questioning. **Verbal instructions** should as far as possible be avoided, as these are liable to cause confusion, the instructions upon the label should alone be relied on. On the other hand, any **inquiries** should be met with a clear explanation, that the customer may be perfectly satisfied.

EXTEMPORANEOUS COMPOUNDING.

Compounding, or the art of combining remedies, more commonly called the "mixing of medicines," is that division of dispensing which involves, besides **mechanical** skill, also the application of pharmaceutical knowledge.

The compounding of official preparations has been described under the different classes of these already treated; unofficial preparations belonging to these classes are made by the same processes.

Many mixtures are compounded as needed—**extemporaneously**—and of these some are not even stable, or lack other char-

acteristics, which render necessary especial methods for their preparation.

Mixture, in a pharmaceutial sense, is a term applied to any compound of different substances mixed or brought together mechanically. These may be either liquid or solid, and in the former is frequently a clear solution.

The official term, **mistura** (mixture), is also designed to indicate the class of preparations in the U. S. Pharmacopœia in order to distinguish them from more definite compounds or solutions.

The employment of the term "mixture" here means compounds, or preparations, not official, or directed to be prepared extemporaneously. The greatest number of these are prescribed by physicians, and are therefore treated here in connection with the compounding of prescriptions.

Care should be observed that all mixtures, especially solutions, be made to appear as clear and inviting as possible.

Solutions of salts, or mixtures of liquids, should always be strained whenever the matter rejected is **inert.** As the appearance of a mixture frequently depends upon the method employed in its preparation, the principal points to be observed will be here presented.

In compounding liquid **mixtures,** the most active constituent or base is diluted with the vehicle, or a portion of it, if this is in excess.

If it contain a **solid,** mixture should be effected either by first reducing the solid to a **powder** in a mortar and triturating with the liquid, or, if soluble when contained in a test-tube or capsule by the application to it of **heat.** The substance next in order of activity should then be added, but in such a manner as to avoid decomposition or change, if indicated by its character.

In compounding **solids,** the same general rule should be observed, except that the base must invariably be reduced first to a **very fine powder** or to a **semi-liquid** consistence. It should then be incorporated with a portion of the **excipient, diluent** or **vehicle,** according as it is to be a pill, powder or ointment, until a perfectly homogeneous mixture is obtained. It is then easily mixed with the remainder of the forming body the Vehicle, to which have been added other active constituents, if present, in case these should be incompatible.

The following mixtures of Solids are unofficial:

FOR INTERNAL USE.

Capsulæ Amylaceæ.—Cachets.—Wafers—Consisting of two concentric halves made of starch enclosing the drug fastened together by moisture. Each cachet contains one dose and is to be immersed in water immediately before being swallowed.

Capsulæ Gelatinæ.—Capsules.—Made of Gelatin consisting of two parts to be filled with solid or liquid (oil) and closed with a tight-fitting cap.

Lamellæ.—Thin, square disks of glycerinated-gelatin in which medicinal agents have been dissolved.

Pastillæ.—Pastills—Lozenges made of glycerinated-gelatin.

Tabellæ. Tablet-Triturates—Disks composed of Triturations massed with Alcohol, or Milk Sugar made into a paste with an alcoholic solution of medicinal substances and moulded so as to weigh about 65 mg. (1 grain).

Linctus.—A thick medicated syrup.

Pasta.—Paste—Similar to confections; also mixtures of medicinal agents of ointment-consistence for **external** use.

FOR EXTERNAL USE.

Carbasus.—Antiseptic Bandages.—A fabric of loose texture—Cheese-cloth—saturated in solutions of antiseptic agents in water or alcohol and glycerin, pressed out and made into rolls of 5 yards and wrapped in paraffined paper and kept in air-tight packages. The **strength** should refer to the **percentage strength of the solution** used except of **insoluble** agents such as iodoform.

Candulæ.—Bougies.—Pencil-shaped Suppositories for medication of the Urethra or air-passages.

Insufflations.—Finely powdered substances for blowing into the air-passages.

The directions given for the preparation of Emulsions, Ointments, Pills, etc., in previous Lectures are typical of these classes, and should be followed in extemporaneous practice. In the following, only examples which are exceptions to the general methods are given.

INCOMPATIBILITY.

When different substances are brought together in a mixture, be it liquid or solid, with the result of undergoing a more or less complete change, they are said to be **incompatible.**

This does not apply to the chemical compounds, or even to some mixtures where the resulting change produces a new compound or compounds desired for use; as, for example, in the preparation of Liquor Ammonii Acetatis or Mistura Ferri Comp. Aside from this consideration, substances of very decided incompatibility are often directed to be mixed **intentionally** with the object of forming a new compound or compounds, for special reasons.

It will thus be seen that the term incompatibility in the generally accepted pharmacal meaning, is not always clear, and not invariably indi-

cative of impracticable, unsafe, or otherwise undesirable combinations. There are indeed few instances in which the cause of incompatibility in a mixture cannot be accounted for by well-known chemical principles, and with these could also be explained, were our knowledge sufficiently complete.

The only really **scientific method** of determining the incompatibility, or the contrary, of the ingredients of a mixture is a correct knowledge of chemical laws, and their practical application in pharmacy.

For the purpose of practical work in pharmacy, and especially in that pertaining to prescriptions, a generalization may be attempted by bringing together the more important substances, often directed to be compounded.

Incompatibility may be distinguished as being either of the following: (1) Chemical, or (2) Pharmaceutical.

Chemical incompatibility is of the greatest importance, because the change is usually more decided between chemical compounds than between preparations of vegetable drugs, the latter involving chiefly the solubility of their constituents, their mechanical suspension or other physical treatment.

The most common forms of chemical incompatibility occur under the following conditions:

(1) When the solutions of two salts are mixed, resulting in the formation of a **new salt,** which, being **insoluble,** precipitates:

℞ Plumbi Acetatis, Zinci Sulphatis.......ana 1.0
Aquæ Rosæ 50.0
M. et S. Shake well and use as an injection.

Here the prescriber desires to exhibit Lead Sulphate, in its freshly prepared state, and directs it to be formed by double decomposition between the two salts, Lead Acetate and Zinc Sulphate. The Sulphuric Acid radical having greater attraction for the Lead, leaves its own base and combines with the Lead, forming Lead Sulphate, while the weak acid, Acetic, being displaced, combines with the Zinc, forming Zinc Acetate, which remains in solution. The Lead Sulphate being insoluble is precipitated as a dense, white powder, but upon shaking the mixture, it is temporarily suspended, hence the necessity of directing the bottle "**to be shaken**" when the contents are to be used.

A similar decomposition of two soluble salts may, however, under certain conditions not always be desired, or, in fact, not suspected, as illustrated in the following:

℞ Quininæ Sulphatis ....gr. xx
Potassii Acetatis ....gr. xxx
Acidi Sulphurici diluti ....m. x
Aquæ ....f. ℥ iss
Syrupi ....f. ℨ iv
M. et S. One dessertspoonful every (3) hours.

In compounding the above, the Quinine Sulphate is dissolved in a portion of the Water, by the aid of the Acid, and added to the potassium Acetate, previously dissolved in the remainder of Water, the Syrup being added last.

Upon the two solutions being mixed, the acids exchange their bases, resulting in the formation of Potassium Sulphate and Quinine Acetate, the former remaining in solution, while the quinine salt, being almost insoluble, is suspended in the liquid. It is not precipitated, as is the case in the first example, owing to its bulk and light weight, but remains permanently suspended in the liquid, giving to the mixture a consistence which prevents it from being poured. Quinine sulphate being almost insoluble in water, its solution is affected by converting it into the much more soluble Bisulphate by the addition of Acid, but the latter also combines with the Potassium and hence does not prevent the formation of the almost insoluble salt. By addition of an excess of the acid, the quinine is kept in solution.

(2). With solutions of salt of **weak** or **volatile acids**, by the addition of a **strong acid,** when decomposition results.

Several official preparations and other mixtures are prepared extemporaneously, by decomposing an alkaline carbonate with an acid, such as acetic, citric or tartaric acids. The Solutions of Ammonium Acetate, Magnesium Citrate and Sodium Tartrate are good illustrations.

The carbonic acid of the respective carbonates is easily displaced by the acids mentioned, and, being volatile, escapes, though a portion of it may be retained in the solution if kept in a closed vessel.

In these the decomposition is **intentional,** and since definite compounds in an eligible form are produced, the solutions can not be regarded as incompatible mixtures. But in the case of many pharmaceutical preparations containing acids, i. e., Vinegars, and especially when viscid, as, for example, the Syrup of Squill, prepared from the vinegars; or of some Fluid Extracts, such as that of Uva Ursi, the addition of an alkaline carbonate produces effervescence and sometimes explosion. Such mixtures should be prepared by adding the vehicle to the solution of the salt in a mortar, under constant stirring. The thinner the liquid the more quickly will the gas escape, hence the solution should be diluted with as much water as is permissible.

(3). Salts of a **feeble** or **volatile base** are decomposed by the addition of a **strong alkali.**

Examples of this are rare; it may be illustrated in the evolution of

ammonia, when a strong alkali is added to ammonia-alum and in the decomposition of **Chloral Hydrate by alkalies.**

(4). **Alkaloids**, by the addition of **alkalies** or alkaline salts, are thrown out of solution or precipitated from solutions of their more soluble salts.

The Alkaloids, with but few exceptions, are nearly insoluble in Water, but their Salts, such as the Acetates, Hydrochlorates and Sulphates are comparatively soluble in Water and other neutral or acid liquids. They are, moreover, very potent medicinally, and hence administered in very small quantities, so that the alkali Salts, usually prescribed in much greater proportion than the alkaloid Salts, may abstract the acid from the alkaloid with the result of throwing the almost insoluble base out of solution. Or what is more frequently the case, even if the alkaloid be soluble as a base in the neutral liquid, the alkalinity of the mixture is sufficient to precipitate it.

Alkaloids are precipitated in aqueous solutions of **Alkaline Bromides;** the alkaloid bromides formed through interaction are insoluble in water but will be kept in solution with about 25 per cent of **Alcohol.** Illustrations may be mentioned of mixtures containing **Strychnine Sulphate** and **Potassium Bromide,** the latter in much the largest proportion, and similar preparations. The Alkaloids and their Salts are also incompatible with those chemical compounds with which they produce characteristic reactions. (See Alkaloids.)

(5). **Iron** and many of its compounds, upon the addition of **Tannic Acid** and preparations containing it, Gallic Acid, or other vegetable Acids, produce a **discoloration** or precipitation.

This is a common form of incompatibility and is illustrated, when intentionally employed, in the preparation of ink; this discoloration of mixtures is also often termed "inky." Many examples might be given, but since nearly all vegetable drugs contain more or less of these acids, their preparations are often discolored, when mixed with iron compounds.

The discoloration may be **prevented** by employing certain iron preparations, or compounds of these with other salts, i. e., ammonium or sodium citrate. Especially is this the case with preparations of drugs not containing tannic or gallic acids, but some other vegetable acid, similar to these in being discolored by iron. The most familiar illustration of this is the formula for Elixir Gentian with Tincture Chloride of Iron, N. F.

Here the familiar discoloration of the gentisic acid with the tincture of iron chloride is prevented by the use of the citro-chloride of iron.

PHARMACEUTICAL INCOMPATIBILITY.

The production of more or less **insoluble** substances in mixtures or preparations associated or not with chemical change, is termed **pharmaceutical** incompatibility.

Pharmaceutial incompatibility is largely a question of **solubility**

and therefore requires for its understanding a knowledge of the behavior of substances to various solvents; the degree of solubility of the many salts and chemical compounds as well as the reactions these produce with pharmaceutial products and preparations. While these are usually not as marked as are the reactions between chemical compounds they frequently result in the formation of insoluble compounds, which should, whenever possible, be prevented without affecting the therapeutic properties of the mixture.

In **liquid** Mixtures, incompatibility is most frequently due to a **change in the vehicle or solvent,** by the addition of one solution to another causing separation of inert, or active, constituents.

When the separation is of inert constituents only these should be removed my straining or filtration; when of active constituents their separation may often be prevented or at least greatly lessened by either of the following methods:

By **dilution**; the greater the extent of dilution the less the danger from precipitation.

Preparations of drugs containing oils, resin or oleoresin, made with alcoholic menstrua, precipitate, or cause turbidity, when mixed with aqueous mixtures, or those containing only small proportions of alcohol. But by diluting a tincture, or a spirit of these, with less than its measure of diluted alcohol, it may often be added to watery solutions or mixtures, without producing precipitation if not turbidity.

By **suspension**; the greater the density or viscosity of the liquid, the less the danger of change or precipitation.

With many mixtures, dilution can not be practiced; in such cases recourse is had to suspension, by means of **intervention,** through some inert substance. The best general agent to serve this purpose is **acacia.** Preparations of the class above described, resinous drugs, etc., can be mixed with watery solutions to which some acacia, either in the form of powder or mucilage, has previously been added, by trituration in a mortar; or by shaking in a bottle. **Honey** also serves admirably, especially with **Alcoholic** liquids, such as tincture of Benzoin in which gums would be precipitated by the alcohol.

Solubility must always be considered in all solutions or liquid mixtures. In simple solutions, the active constituents may be directed in larger quantity than soluble in the liquid.

Solutions are called **supersaturated** when they are saturated solutions at a temperature **higher** than the ordinary and therefore the excess of solid will be thrown out of solution when the liquid assumes the **normal temperature.**

In preparing mixtures directing a greater proportion of solid than soluble in the liquid, as in the case of a salt, Potassium Chlorate, for example, it should be added in the form of **powder** and the mixture directed to be shaken while being used. It may be a liquid and differ in specific gravity from the vehicle, in which case the excess will either **float** upon the latter, as with a mixture of Carbolic Acid and Water, or of Chloroform and Water, remain in a stratum at the **bottom.** In the first instance the addition of a little Glycerin will aid the solution of the Carbolic Acid.

It may be more complicated, and a potent, or, as in the following case, an exceedingly poisonous substance may be extracted from the mixture by the separated liquid, because easily soluble in the latter:

℞ Tincturæ Nucis Vomicæ .... 10.
Chloroformi .... 10.
Aquæ ....q. s. 100.
M. et S.

Upon standing, this mixture separates, the Chloroform sinking to the bottom, carrying a portion of the active principles of the Nux Vomica with it. The last dose may contain a poisonous quantity, and great caution must be observed in compounding prescriptions of this class.

With **Solids,** when different substances are acted upon when mixed, **dilution** often prevents undesirable changes.

In preparing ointments, pills and suppositories, care should be observed that active medicinal substances, when of such character, are each diluted with the vehicle, or excipient, before they be mixed together. Tannic Acid is often directed to be prepared in ointment, or suppository, with Extract of Belladonna, with which it forms an insoluble compound. But when each active constituent is first incorporated with a portion of the vehicle, Lard or Oil Theobroma, no change takes place when mixed, and a smooth and active preparation is easily produced.

Incompatibility may sometimes be both **chemical** and **pharmaceutial.**

Illustrations of this are frequently found in mixtures containing Quinine, associated with some chemical compound, or acid, and a vehicle; which is decomposed by the latter, as in following:

℞ Quininæ Sulphatis .... 4.
Ammonii Chloridi .... 6.
Elixir Glycyrrhizæ aromatici ....150.
M. et S.

Here a reaction takes place between the two salts, with the effect of throwing the active principle of Glycyrrhiza, **glycyrrhizin,** out of solution. The same change occurs when diluted Sulphuric Acid is used, and a clear mixture can be obtained only by leaving out the liquorice. Quinine can be eligibly exhibited, in liquid, either suspended in a viscid liquid, such as syrup of glycyrrhiza, in alcoholic solution, or, in solution, by the

aid of acids; a compromise between these, when in large doses at least, is rarely desirable.

In the following list, the substances, which can not be classed as incompatible under any of the above divisions, are given for reference:

Substance.	Incompatible with
Acacia	Alcohol, alcoholic and ethereal Tinctures;* Borax Ferric chloride; Lead salts.
Acids, in general	Alkalies, Alkaline solutions; Metallic Oxides.
Acid Arsenous	Ferric Hydroxide; Magnesia; Lime water.
Salicylic	Iron compounds; Potassium iodide;* Lime water.
Tannic	Alkalies, carbonates and bicarbonates; Lime water; Chlorine water; Albumen; Gelatin.
Bismuth Subnitrate	Calomel; Sulphur; Tannin.
Chloral Hydrate	Alkalies, carbonates;* Ammonium and Mercury compounds; Potassium bromide and Alcohol.
Iodine	Ammonia;* Alkalies, carbonates; Chloral; Metallic salts; Starch.*
Lead, Acetate	Acacia; Acid Hydrochlor; Acid Sulphuric and sulphates; Ammon. chloride; Carbonates; Lime water, Iodine; Potassium; Iodide; Tannin.
Mercury Bichloride	Potassium iodide;* Salts, Alkaloids, carbonates; Tannin, Borax.
Mild Chloride (Calomel)	Acids, acid salts; Alkalies, carbonates; Ammon, chloride; Iodine; Potassium iodide; Ferric chloride; iodide; Sulphur.
Potassium Chlorate	Acids, minerals; Calomel; Organic substances; Sulphur.
Iodide	Acids, acid salts; Alkaloids; Iron; Lead and Mercury salts; Potassium chlorate; Silver nitrate; Chlorine water.
Permanganate	Ammonia, salts; Alcohol; Glycerin; Ethereal oils; Organic substances.
Sodium Bicarbonate	Acids, acid salts; Acid Tannic; Alkaloids; Metallic salts.
Bromide	Acid mineral; Chlorine water; Mercury compounds.
Silver Nitrate	Acids Acetic, Hydrochloric, Hydrocyanic, Sulphuric, Tartaric, and their salts; Alkalies, Carbonates; Iodine; Potass. iodide, bromide; Sulphur.

Those marked with an* are sometimes directed to be compounded for the purpose of effecting some especial change or producing new compounds.

TERM I EXAMINATION, SERIES 21.

INCLUDING QUESTIONS ON LECTURE XI AND XII.

All rules pertaining to the method of answering in ''Important Notice must be observed.

1. Define Pharmacy.

2. What is the United States Pharmacopœia and what is its object?

3. Mention the 3 Systems of Weight in common use in pharmacy.

4. State number of **grains** in one fl. oz. of Water, in one tr. oz., in av. oz., in one Gram, in one Liter of Water.

5. Convert into the Metric System, 3 lbs. av.; 4 oz. tr.; 60 grains; 16 minims; 9 fl. oz.; 1 gallon.

6. Convert into the Apothecaries System, 50.0; 8 K.; 0.001; 6 cg.; 5 Gm.

7. What is the sp. gr. of a liquid that has the sp. vol. 0.820?

8. How much does one L of Syrup (sp. gr. 1.31) weigh? What is the cost of 10 Liters of Syrup at 5 cents per pound?

9. How is the Degree of Heat measured? Mention the 3 Systems in use.

10. Define distillation and Sublimation and state how Sublimation differs.

11. What is the object of using **baths** in the various processes involving heat?

12. Convert 50°F. into C. degrees. Convert 40°C. into F. degrees. Convert 10°R into C. degrees.

13. Define Exsiccation and Desiccation and state how Desiccation differs.

14. Define Comminution, and mention the operations involved.

15. Define Solution and Dialysis and state how Dialysis differs.

16. Define Filtration, Clarification and Decolorization.

17. Define Extraction, Percolation, Maceration, Digestion.

18. Mention the three official Classes of inorganic compounds.

19. Enumerate the Haloid acids, and their official **forms**, with **strengths.**

20. What is the percentage strength of **most** of the **official dilute** acids?

21. Mention three official Compounds of I, and one official Compound of P.

22. Mention three official Preparations of I and one official Preparation of P with **strengths.**

23. Mention the official Latin and English Title and Common Names of the 4 official Arsenic Solutions, and state how much arsenic is contained in 25 minims of each.

24. To what Class of compounds do Caustic Potassa and Soda belong?

25. Mention the official products of the destructive distillation of Wood.

26. Describe **alcoholic** Fermentation, and the 4 steps in producing Alcohol.

27. Mention the official **forms** and preparations of Ethyl Oxide, and Ethyl Nitrite, with **strengths.**

28. What is the composition of a Carbohydrate, and in what **proportion?** Mention the principal Carbohydrates.

29. Mention the official **kind** of Starch.

30. How do Volatile Oils **differ** from **fixed** Oils?

31. Classify the Volatile Oils; mention their Adulterations with means of **detection.**

32. Define and distinguish between Resins, Oleoresins, Gumresins, and Balsams.

33. Mention ten Aromatic Drugs, from which official Volatile Oils are obtained.

34. What is the **principal** pharmaceutical use of Resins and Oleoresins? What do Gumresins **yield** when triturated with Water?

35. How are fixed Oils classified?

36. What chemical test is employed to distinguish between **drying** and **non-drying** Oils? Mention the official representatives of each Class.

37. What two official Acids are obtained from Nutgall and **how?** How are they **distinguished** by chemical test?

38. How do Glucosides, Neutral Principles and Alkaloids **differ** in their chemical constitution?

39. How are the above mentioned **distinguished** in their Reactions with acids and alkaloids?

40. Mention **specific** identity tests for Quinine, Morphine and Strychnine.

41. Mention an example each with strength, of a Water made by (1) **simple** solution, (2) solution by intervention, (3) distillation, (4) chemical reaction and absorption.

42. Distinguish between Waters, Solutions and Spirits.

43. Mention three official Iron Solutions, with **strengths,** and **specific gravities.**

44. How is Spirit of Nitrous Ether prepared? State **strength,** and **method** of assay.

45. How much Strychnine Sulphate in **grains** is contained in 1 fl. dram Elixir Iron, Quinine and Strychnine Phosphate, U. S.?

46. Define an Emulsion. Write out the quantities necessary to make Emulsion of Cod-liver oil, 500 c.c., containing 25% of oil.

47. Mention the Products by Extraction whom the **weakest** to the most **concentrated.**

48. Define a Fluid Extract. Mention the official **methods** of preparation.

49. If the dose of a Drug be 0.5, what would be the dose of the Infusion, Tincture (10%) Fluidextract, Extract (yield 10% Resin (yield 5%), and Alkaloid (yield 1.5%)?

50. How may from a **powder** be made the balance of the mixtures of Solids for **internal** use? How do the Mixtures of Solids for **external** use differ from each other Physically?